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PENICILLIN IN MASTOIDITIS AND ITS COMPLICATIONS

MAJOR F. J. PUTNEY

MEDICAL CORPS, ARMY OF THE UNITED STATES

The clinical use of penicillin in the treatment diseases of the ear was first reported by Florey Florey[1] in March 1943. They reported cases of mastoiditis in which the patients e treated postoperatively by local instillation penicillin. I have used penicillin clinically Bushnell General Hospital since April 1943, it is the experience gained from this treatnt of various otologic diseases on which this er is based.

n this series of 10 cases of mastoiditis and its plications, the organisms, either streptococci staphylococci, were found to be sensitive to icillin, and their growth was inhibited by unit or less of penicillin per cubic centimeter culture. None of the causative bacteria in se cases became resistant to the drug. In experience, failure of organisms to respond penicillin has proved to be due to a resistant terial strain. When, after three or four days therapy with penicillin, there has been no provement in the appearance of a wound and ulent drainage continues, one should suspect t the organism is resistant to the drug, and s for sensitivity should be made.

Adequate surgical intervention, in addition to atment with penicillin, was necessary to effect cure in the majority of my patients. One iking phenomenon noted in the persons who re receiving the drug was the rapidity with ich seriously ill patients became symptom free. decided decrease in pain with a general feel- of well-being was usually noted within the st forty-eight hours of treatment.

Originally I administered penicillin intravesly, either by repeated venous punctures every o hours or by continuous drip. Both of these thods have largely been supplanted by the ramuscular route. Continuous drip administration may still be preferable for extremely ill patients with grave infections when a high, prolonged blood concentration is desired. Penicillin used locally is also bacteriostatic, but I have not depended on local use alone and have usually combined local with systemic administration. In general, the dosage employed was 25,000 units intramuscularly every three hours, which was reduced to 15,000 units as the patient improved, the three hour interval being maintained. In this series of cases no toxic reactions to the drug, either systemically or locally, were encountered.

In the postoperative care penicillin was used locally by one of the following methods: (1) irrigation through a rubber Dakin tube after primary closure of the wound, (2) irrigation to the open mastoid cavity or (3) packing the open wound with gauze impregnated with penicillin at the daily dressings. In most of the cases in which complications were present, the wound was left open and a secondary closure was performed from seven to ten days later, but I have since found that these wounds can be closed primarily with little hazard, provided the patient is receiving penicillin systemically and local application is continued.

After simple mastoidectomies and closure of the wounds, local penicillin irrigations were employed without intramuscular use in 4 cases, and prompt healing resulted. To patients with complicated mastoiditis, penicillin was given systemically as well as locally. In my experience it has not been necessary first to remove the secretion from the mastoid wound before irrigating with penicillin. It makes little difference whether the drainage tube is placed at the superior or inferior end of the wound; but when it is fixed at the upper end, gravity seems to aid in retaining the penicillin solution in the mastoid cavity, and the leakage is less than when the tube is in a dependent position. The strength of the solution used locally was 250 units per cubic centimeter. The healing of indolent wounds that continue to drain after mastoidectomies may be hastened by the local application of penicillin.

From the Ear, Nose and Throat Unit of the Surgi- Service, Bushnell General Hospital, Brigham City, ah.

1. Florey, M. E., and Florey, H. W.: General and cal Administration of Penicillin, Lancet **1**:387 (March 1943.

THROMBOSIS OF THE LATERAL SINUS

Six patients with thrombosis of the lateral sinus have been treated with penicillin. Early in the series I operated on the lateral sinus first, giving penicillin postoperatively, while later the drug was given preoperatively. By either method the results appeared equally satisfactory, and no appreciable difference was noted. By using penicillin preoperatively, however, control of the acute phase can be attained before operation; so this plan of therapy seems preferable and has been adopted. In any event, the thrombus should be removed, else recurrence is likely. In three instances it was not possible by the usual methods to remove the clot from the jugular bulb, but no complications developed, and recovery was not retarded. I am of the opinion that penicillin, by combating the formation of a septic thrombus, is of definite value and is an added precaution in preventing the spread of the disease. The rapid response of the infection to penicillin is seen in the prompt decline of temperature, disappearance of headache, general feeling of improvement and sterilization of the blood stream. The results that would have been obtained in these cases without penicillin is problematic, but even though the jugular vein of only 1 patient was ligated, the patients recovered rapidly after the use of the drug. Routine dosage of 25,000 units of penicillin intramuscularly every three hours reduced to 15,000 units as improvement resulted was generally practiced. In 1 case (no. 6) sterilization of the blood stream was accomplished thirty-two hours after therapy was started. In another case (no. 5) a thrombosis of the lateral sinus developed after the patient had received penicillin. The latter case emphasized again that penicillin alone is not sufficient to cure or prevent thrombosis and that surgical intervention is an equally important factor in obtaining permanent healing.

CASE 1.—This 27 year old sergeant suffered an attack of acute suppurative otitis media on the left side after an acute nasopharyngitis had subsided. He was treated at his station hospital and given 1 Gm. of sulfathiazole four times a day, but this treatment was discontinued after five days because of a generalized dermatitis. Twelve days after the onset of otitis media he experienced a chill, temperature of 103.6 F. and headache, with an increased purulent discharge from the left ear.

The next day the patient was transferred to Bushnell General Hospital. There was no fever at the time he was admitted, but the following morning the temperature was 104 F. Examination revealed nothing abnormal except acute illness and drowsiness and a discharging left ear with frontal headache and tenderness over the left mastoid. Intramuscular injections of penicillin were started in 25,000 unit doses every three hours, and after forty-eight hours the temperature became normal. The drug was continued for one week, and at the end of this time the fever and headache had d appeared, but an aural discharge and tenderness o the mastoid persisted. Three days after the drug h been discontinued the temperature began to spike 101 F., and the purulent discharge from the audit canal became more profuse. Four days later, after t use of penicillin had been resumed, a mastoidecto was performed, and a thrombus was removed from t lateral sinus. Cultures of the blood had been consiste sterile, but a pure growth of Streptococcus (beta he lytic) was obtained from the mastoid wound. The op ative wound was not closed, and local irrigations w penicillin together with intramuscular administrati were continued for one week. Cultures from the wo at the end of this time contained no organisms, and secondary closure was performed. The patient recei a total of 2,360,000 units of the drug in a period e tending over sixteen days. He was able to return duty after a therapeutic furlough.

CASE 2.—An 18 year old soldier was admitted to t hospital critically ill, with a temperature of 105.4 F. a in a stuporous condition. Nineteen days previously had contracted nasopharyngitis and otitis media of t right side which had been treated with sulfadiazi The day after the patient was admitted an operati was performed, and an organized thrombus was remov from the right lateral sinus, and the right jugular v was ligated. After the operation he was given intensi continuous intravenous injections of penicillin, receiv 5,000 units every one-half hour. These injections w continued for two days. He then began to receive 15,0 units intravenously every three hours for seven da making a total of 1,260,000 units. When therapy w instituted, the patient was comatose, with a temperatu of 106.2 F., and within eight hours he was fully co scious and ate a regular meal. The temperature ca down to normal in thirty-six hours and remained norm thereafter. Cultures from the mastoid at the time operation revealed hemolytic streptococci and Staphy coccus aureus, and daily smears and cultures thereaf failed to reveal the presence of any organisms. T open wound was dressed daily with local penicillin, a two weeks later a secondary closure was performe Recovery was uneventful, and the patient left the h pital in excellent condition.

CASE 3.—A 19 year old sergeant had a simple ma toidectomy on the left side performed at his stati hospital for an acute purulent otitis media and ma toiditis of three weeks' duration. Sulfathiazole w administered for twelve days after the operation, a the temperature became normal on the fourth po operative day. Nystagmus to the opposite side a severe headache on the left side lasted for one we after the operation and then subsided. Purulent di charge continued from the external auditory canal, a on the fifteenth postoperative day the patient suffer a chill with a rise in temperature to 104 F. He w immediately sent to Bushnell Hospital. He appear drowsy, and examination revealed a headache on t left side and some tenderness over the left jugular ve No neurologic signs could be elicited, but the temper ture ranged between 103 and 104 F. for the first da and beta hemolytic streptococci were present in t drainage from the left ear. Penicillin was started a dosage of 25,000 units every three hours intramu cularly, and after three days it was reduced to 15,0 units and continued for the next four days. During t week of treatment the patient received 1,175,000 un of the drug, and forty-eight hours after the initial do the temperature became normal and remained at th level. The presumptive diagnosis in this case was later

s thrombosis, but, since operation was not performed, diagnosis could not be substantiated. This was the patient cured by penicillin without the use of surgical procedures, and since the diagnosis was not confirmed, the result could not be considered decisive.

ASE 4.—After a 21 year old sergeant had scarlet r, an acute suppurative pansinusitis on the left side loped. Two weeks later he had an acute purulent s media on the left which progressed to an acute toiditis. Aural discharge and slight elevation of perature continued for the next three weeks in spite ulfonamide therapy. At the end of this time drowsi- and vomiting occurred, and the patient was trans- d to Bushnell Hospital.

hen the patient entered the hospital, there was a e amount of purulent discharge from the left ex- al auditory canal and in the left side of the nose. was apathetic and stuporous but reacted well to uli. He was compelled to hold his head either ight forward or on the right, for any other position uced vomiting and dizziness. Horizontal nystagmus he right on looking to the right was noted. Results eurologic and spinal fluid examinations were nega- except for a positive Queckenstedt reaction on the side. Results of cultures of the blood remained ative.

he patient was operated on, and an organized throm- was removed from the left lateral sinus. Free ding occurred from the upper end of the sinus, but flow of blood could be obtained from the jugular . Culture from the mastoid revealed a beta hemo- streptococcus. The jugular vein was not ligated, the wound was left open with light packing in e. He was then given penicillin in the dosage of 00 units intramuscularly every three hours, which later reduced to 15,000 units, together with local illations of the drug every three hours into the nd. He was treated for a total of ten days and ived 1,340,000 units of the drug systemically. A sec- ary mastoid closure was performed, and the patient vered without further complications.

ASE 5.—A 21 year old soldier had nasopharyngitis plicated by acute otitis media and mastoiditis. A le mastoidectomy on the left side was performed is station hospital. About twelve hours later there loped convulsive seizures of the jacksonian type on right with loss of consciousness and temperature 06.4 F. Exploration and decompression of the left dle and posterior cranial fossae were done, but there no evidence of extradural abscess, and the lateral s was opened and said to be normal. After operation had an aphasia with weakness on the right side and of the deep reflexes on that side. He was then given icillin for six and a half days, receiving about 5,000 units systemically and intrathecally. He was sent to Bushnell General Hospital.

fter the patient was admitted, his condition remained ut the same for three weeks, with aphasia, weakness apathy, but then nausea, vomiting, chills and fever rred. The mastoid wound was reopened, and a mbus of the lateral sinus was uncovered from be- d the upper knee to the jugular bulb. The clot was oved from everywhere except the bulb end where ould not be dislodged. The cultures from the mastoid thrombus revealed beta hemolytic streptococci, but tures of the blood were sterile. The patient was en penicillin intramuscularly and locally for nine s, receiving an additional 1,380,000 units. There was dual improvement in the aphasia, and the weakness reflex changes disappeared. The patient gained weight and, after a secondary closure of the mastoid wound, recovered without further complications.

CASE 6.—After an acute infection of the upper respiratory tract a 21 year old soldier had pain and discharge from the right ear. He was hospitalized at his station hospital and given chemotherapy (sulfadiazine). Drainage continued for one week and then ceased, and the use of sulfadiazine was discontinued. Three days later the purulent discharge recurred, and the patient was treated with sulfathiazole and roentgen ray therapy. Profuse drainage continued for another week, and at the end of this time he began to have septic fever with the temperature elevated up to 104 F. accompanied by chills, which usually occurred in the afternoon.

When he was admitted to Bushnell General Hospital, there was a profuse purulent discharge from the right ear with tenderness of the mastoid. There was roentgen evidence of mastoiditis. A spiking temperature up to 103.4 F. occurred on two successive days, and cultures of the blood at these times revealed heavy growths of beta hemolytic streptococci. The patient was treated with penicillin, receiving 25,000 units intramuscularly every three hours, and an operation was performed the following day. At operation the lateral sinus was found to be thrombosed from beyond the upper knee to the jugular bulb. The clot was removed from the upper end and free bleeding occurred, but all of the thrombus could not be evacuated from the bulb end. The upper end of the sinus was closed with black silk sutures and the lower end left widely open. The jugular vein was not ligated. A rubber Dakin tube was inserted from the upper end of the wound and the skin edges tightly closed. Cultures from the mastoid cells and the thrombus of the lateral sinus also revealed a beta hemolytic streptococcus. Penicillin irrigations (5 cc. of 250 units per cubic centimeter solution) were carried out through the rubber tube every three hours along with the systemic treatment. A culture of the blood taken six hours postoperatively, after he had received thirty-two hours of treatment with penicillin, was reported as sterile. The temperature fell to normal, and the cultures remained free from organisms. The wound healed primarily, and the systemic administration of penicillin was discontinued after nine days of treatment and after 1,320,000 units of the drug had been administered. The drainage tube was removed in seven days. There was no discharge from the wound or auditory canal after the operation, and the patient's recovery was rapid.

MASTOIDITIS, PETROSITIS, MENINGITIS, AND EXTRADURAL AND CEREBELLAR ABSCESS

In this group 4 patients with miscellaneous conditions were treated. The case of mastoiditis is included to show that there was improvement with use of penicillin without cure, until mastoidectomy was performed. Healing was obtained in a patient with petrositis and serous meningitis through treatment with penicillin plus a simple mastoidectomy. In the case of extradural abscess and meningitis, an operation was performed, followed by treatment with penicillin. It seems likely that surgical measures would have been sufficient to eliminate the infection in this case, but because of the possibility of a latent brain abscess the drug was administered.

The infection in the mastoid was controlled by the drug in the case of cerebellar abscess, but the signs of cerebellar irritation continued even though the temperature became normal. At operation the pus in the brain abscess was found to be sterile, demonstrating the efficacy of the drug in eliminating the bacteria, but healing was not obtained until surgical drainage had been instituted.

Meningitis was present in 3 of the cases without demonstrable organisms in the spinal fluid. It is known that penicillin does not readily infiltrate into the cerebrospinal fluid but can be used with safety to produce a therapeutic effect when given directly into the spinal canal. Because of the negative spinal fluid cultures none of the patients with meningeal involvement received the drug intrathecally. In the presence of susceptible bacteria in the spinal fluid my feeling is that intrathecal therapy is indicated. Physical signs of meningeal irritation and spinal fluid findings of increased pressure and leukocytes do not in themselves constitute sufficient reason for using intrathecal injections of penicillin.

CASE 7.—*Acute purulent mastoiditis.*

Prior to the onset of a nasopharyngitis and acute suppurative otitis media, this 19 year old patient did a great deal of swimming and diving. Sulfadiazine was prescribed for thirteen days, but its use was discontinued because of a generalized dermatitis. The right ear continued to discharge, and one week later the patient had an acute suppurative mastoiditis with a temperature of 101 F. and roentgen evidence of cloudiness of the mastoid cells and bone destruction in the tip and about the antrum. Cultures were reported as growing Staph. aureus haemolyticus.

On admission to Bushnell Hospital the patient was given treatment with penicillin and for the next twenty-one days received 2,760,000 units of the drug intramuscularly. Within a week the fever and mastoid tenderness had vanished. There was a diminution in the aural discharge, and roentgen studies showed no progression. Improvement was gradual, but at the end of three weeks there was still a purulent drainage yielding the same organism on culture, with some persistent granulation tissue around the tympanic perforation. Roentgen findings at this time revealed some calcification of the mastoid cells with a tendency toward chronic changes. It was thought that penicillin had been given a fair trial, and an operation was performed to eradicate the remaining purulent discharge. At operation the cells were found to contain gray necrotic tissue but no actual pus, and the results of the cultures were negative. Penicillin was not used systemically postoperatively but the wound was irrigated every three hours with the drug. Wound healing was complete in a week, and there was no further drainage from the ear.

CASE 8.—*Acute suppurative mastoiditis and petrositis.*

A 22 year old sergeant was admitted to Bushnell General Hospital three weeks after the onset of acute purulent otitis media of the right side that had not responded to sulfonamide therapy. At the time of his admission there was a peripheral facial paralysis on the right side which was partial about the eye and upper part of the cheek and nystagmus to the left on lateral gaze. Hypoesthesia of the entire right side of the face with severe pain on that side was present, and the patient was completely deaf in the right ear. No definite weakness was found in the right external rectus muscle, but there was distinct blurring of vision on looking to the right. Extreme tenderness was present over the mastoid antrum, tip and along the zygoma, accompanied by profuse discharge of pus of Staph. aureus haemolyticus from the auditory canal. There was roentgen evidence of suppurative mastoiditis and destruction of the petrous tip on the involved side. The day before a scheduled operation on the mastoid his temperature rose to 102 F. with some nuchal rigidity. The fever was later followed by a chill. The spinal fluid contained 550 cells, but cultures remained sterile. The patient was treated with penicillin for three days, receiving 600,000 units, and at the end of this time the acute meningitic signs had subsided. A simple mastoidectomy was then done, and no lead into the petrous portion of the temporal bone was uncovered, nor was there evidence of an extradural collection of pus. The wound was left open and was irrigated with penicillin every three hours, and a secondary closure was performed ten days following the original operation. The involvement of the fifth, sixth, seventh and eighth nerves on the right side gradually diminished, and the hearing returned to normal, so that on leaving the hospital the patient demonstrated no residual manifestations.

CASE 9.—*Osteomyelitis of the temporal bone with epidural abscess.*

The wife of a naval officer gave a history of having had a simple mastoidectomy on the right side in 1936. About a year before being admitted to the hospital she had an incision and drainage of a subcutaneous abscess at the upper end of the old mastoid scar. For three weeks prior to admission she had experienced severe pain over the right temporal region with tenderness on pressure and had received treatment with sulfadiazine with no improvement. On examination she appeared somewhat drowsy, with a temperature of 102 F., and tenderness over the right temporal region was present. The tympanic membrane was intact, and there were no positive neurologic signs. The day of admission she had a chill, with a rise of temperature to 105.4 F., and appeared more apathetic. The spinal fluid was under increased pressure and contained 423 cells, but cultures subsequently yielded no organisms. She was operated on the following day, and it was found that the lateral sinus was not involved, but there was a large extradural abscess over the temporal region. The bone was removed over an area measuring approximately 5 cm. in its greatest dimension until normal dura was uncovered. There were a large number of granulations over the involved dura with pockets of pus throughout. After the operation she was treated with penicillin for ten days, receiving a total of 1,445,000 units systemically together with local instillation into the wound. The temperature promptly subsided, and improvement began, enabling her to leave the hospital in excellent condition after a secondary mastoid closure had been performed.

CASE 10.—*Acute mastoiditis with cerebellar abscess.*

A 30 year old sergeant was admitted to the hospital with pain over the left side of the head, stiffness of the neck and a purulent discharge from the left ear. The spinal fluid contained 4,750 cells, 93 per cent of which were polymorphonuclears, but no organisms could be demonstrated by smear or culture. The day after

ission the patient was started on treatment with icillin, receiving 25,000 units intramuscularly every e hours, and the following day a simple mastoidec- y was performed. At operation the lateral sinus was lored and found to be patent, but some pus was en- ntered around and below the upper knee. Culture ealed beta hemolytic streptococci. Penicillin was en for twelve days, the patient receiving a total of 5,000 units.

While the patient was under therapy, the fever dis- eared, and the cell count of the spinal fluid dropped 1, but weakness, dizziness, vomiting and nystagmus n. These symptoms together with severe headaches the left side and signs of cerebellar involvement inued until the mastoid cavity was reopened eighteen s after the original operation. At the second opera- a needle was introduced beneath the upper knee he sigmoid sinus into the anterior portion of the bellum, and approximately 7 cc. of sterile pus was uated. The opening into the abscess cavity was rged, and a rubber drainage tube was inserted after abscess was irrigated with penicillin. The wound closed, and instillations of penicillin directly into cerebellar abscess were carried out every three hours the next two days. The rubber tube was then re- ed, and the patient continued to improve, all signs symptoms disappearing.

CONCLUSIONS

Infections of the mastoid and contiguous structures can be readily controlled by penicillin provided the causative organisms are sensitive to the drug. Sterilization of the blood stream and control of spreading infections can be accomplished by systemic administration of penicillin, but surgical intervention is usually necessary to effect a cure. Local application of the drug has proved beneficial in the healing of persistently draining mastoid wounds.

Ten cases are reported which describe brain (cerebellar) abscess, epidural abscess, mastoiditis, thrombosis of the lateral sinus, petrositis and meningitis. It is interesting to note that sulfonamide compounds were administered in 8 of the 10 cases without clearing the infection, but prompt response was obtained from treatment with penicillin. Judging from the results obtained in this small group of cases, I feel that at the present time penicillin in combination with adequate surgical intervention offers the most effective means of combating the serious and life-endangering otologic complications.

MECHANISM OF THE COCHLEA

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Because the cochlea is a minute and delicate organ embedded in thick bone it has been impossible to make direct observations of the events taking place in the inner ear in response to acoustic stimuli. For this reason the dynamic behavior of the ear has been considerably neglected in the formulation of theories of the analysis for pitch. However, a great deal of experimental evidence has come forward during the last ten years which clearly sets down certain fundamentals on which the final picture will be based. In this paper I have attempted to tie all this evidence together into a uniform pattern of thought, so as to present a broad functional analysis of the processes responsible for the subjective discrimination of sound.

COCHLEAR MECHANICS

Although little is known of the physical constants of the inner ear, reasonable assumptions can be made regarding the nature of such factors as the fluid and the elasticity of the basilar membrane which facilitate the setting up of mathematical equations treating the cochlea as a hydrodynamic system. From these equations one can deduce the dynamic behavior of the cochlea in response to mechanical activation at the round window.

Structural Considerations.—The membranous labyrinth is suspended within the osseous labyrinth, which is a series of communicating cavities filled with perilymph and encased in the petrous bone. The walls of these cavities are composed of two tables of hard bone separated by a middle cartilaginous layer. The cochlea, then, may be considered a closed system with rigid walls relieved only by the elastic membrane of the round window.

The perilymph is incompressible, hence significant movements of the fluid within the cochlea, induced by the action of the stapes at the fenestra ovalis, can occur only by virtue of the yielding of the round window which presents the only pathway of low resistance. A slow inward thrust of the stapes must result therefore in a flow of fluid up the scala vestibuli, around the helicotrema and down the scala tympani to the fenestra rotunda. A resultant impulsive wave must travel across Reissner's membrane and the endolymph to reach the basilar membrane; the pressure gradient thus created will then be transmitted to the perilymph in the scala tympani and finally canceled at the round window.

The relatively excessive length of a sound wave of low frequency in a fluid medium as compared with the dimensions of the cochlea render it essential that there be a freely movable element in the system. The length of the fluid column between the oval and the round window through the helicotrema is approximately 60 mm., whereas the wavelength of a tone with a frequency of 20 cycles per second in a fluid such as the perilymph is on the order of 60 meters. The phase difference between the two windows is approximately 0.8 degree; so it follows that with a sound wave of low frequency the movement of the windows and the fluid between them is virtually a mass action.

If this hypothesis is correct, it is obvious that immobilization of the round window should obstruct the entire system and so obliterate the ability to hear. Culler, Finch and Girden[1] have reported just such an effect. They cemented the round window and then recorded both the electrical response and the acoustic reflex to each of various tones throughout the audible range; neither phenomenon could be demonstrated.

On the other hand, in seeming opposition to these findings are the experiments of Hughson and Crowe.[2] These investigators observed that when a pledget of cotton or a periosteal graft is placed over the round window, hearing as measured by cochlear potentials is improved for all tones above 512 cycles per second.

At first glance the two experiments appear to contradict each other completely. However, when carefully interpreted, both sets of results tend to support the theory of cochlear dynamics outlined in this paper. Culler and co-workers' cementing the round window probably restrains all motion of its membrane, thus preventing any significant motion of the perilymph. Conversely

1. Culler, E.; Finch, G., and Girden, E.: Function of the Round-Window in Hearing, Am. J. Physiol. **115**: 416-425, 1935.

2. Hughson, W., and Crowe, S. J.: Experimental Investigation of Physiology of the Ear, Acta oto-laryng. **18**:291-339, 1933; Function of the Round Window, J. A. M. A. **96**:2027-2028 (June 13) 1931.

e placing of a periosteal graft or a pledget of tton on the round window would not necesrily immobilize it but would protect it from r-borne vibrations crossing the middle ear from e tympanum.

The protection of the round window from airrne vibrations may explain the improvement auditory acuity encountered by Hughson and rowe with their procedure. Air-borne vibraons striking the round window are out of phase ith those transmitted to the fenestra ovalis by e ossicles, and they cause equal and opposite essure changes on the other side of the basilar embrane. In other words, the two windows nd to reduce the effectiveness of each other. hus, when the round window is shielded with a edget of cotton or a connective tissue graft that es not restrain its action, the cochlea becomes more effective hydrodynamic system.

Cochlear Hydrodynamics.—The major criticism directed against the popular Helmholtz or mple resonance theory is that there is considerble evidence that the cochlea is a highly damped echanical system. A high damping factor has e effect of blunting the selective response of e mechanism in such a way that a single tone ust activate an extensive area of the neuroithelium.

The high degree of selectivity demanded by e Helmholtz theory requires that the dampg factor of the basilar membrane be small; ence a relatively long period would be required r the system to return to the resting state, beuse of the after-swings due to resonance. owever, the subjective persistence of a discontinued sound, even at high intensities, is of very ort duration, which immediately suggests that e process involved must be highly damped. he criticism that this lack of persistence could cur in central processes is nullified by the obrvation of Derbyshire and Davis [3] that there is o significant persistence of the cochlear microhonic following sudden interruption of a tone. he "off" effect which they describe is a nonecific natural period dependent on the afterbrations of the ossicular chain and on the invitable "click" accompanying the switching off the stimulus.

To be valid, a theory of cochlear dynamics ust take the high damping of the mechanism to consideration. Reboul,[4] assuming that the ochlea follows the mathematical analysis of a itically damped hydraulic system contained in a cylindric vessel with an elastic wall, set up a series of differential equations treating the cochlea as such a mechanism. From these data Reboul demonstrated that when a compressional wave is initiated at the oval window it travels up the scala vestibuli toward the helicotrema, causing the basilar membrane to undergo a maximal displacement at a point governed by the frequency of the impressed force.

If the compressional wave propagated through the tube has a steep wave front, as it would have with high frequency excitation, the greatest distortion must take place in the basal coil. If, on the other hand, the compressional wave front is blunt as with a low frequency force, the maximal displacement must occur in the apical turns. Reboul calculated the positions of maximal stimulation in terms of millimeters from the basal end of the cochlea for several tones in the audible range. His figures, 26 mm. for 2,000 cycles, 12.0 mm. for 4,000 cycles and 11.0 mm. for 8,000 cycles, are in close agreement with figures obtained by empiric methods (see section entitled "Localization of Tones in the Cochlea," p. 256).

Observations of a scale model of the cochlea under stroboscopic illumination [5] revealed that a sudden displacement of the stapes does not cause the aural membrane to move as a whole; as Reboul suggested, a compressional wave is propagated progressively along it. The part of the membrane near the oval window leads in phase that part near the helicotrema.

Reboul calculated that the speed with which such a wave would travel would be on the order of 50 meters per second, the relative slowness being due to frictional factors introduced by the rapidly decreasing dimensions of the tube. Empiric evidence for the slow speed of propagation has been presented by Békésy.[6] The experimental interval of time between the activation of the drum membrane and the arrival of impulses at the round window is a function of frequency. The pressure gradient of the hydraulic impulse short-circuits across the basilar membrane to reach the round window at a point which is dependent on the frequency of the impressed sound.

From studies of the inner ear in cadavers and of his scale model of the cochlea, Békésy [5] concluded that eddies occur in the fluid above the basilar membrane in response to loud tones. He pointed out that if traveling waves occur in the membrane, such eddies would necessarily be an accompanying phenomenon. If the stimuli

3. Derbyshire, A. J., and Davis, H.: Action Potentials of the Auditory Nerve, Am. J. Physiol. **113**:476-04, 1935.

4. Reboul, J. A.: Théorie des phénomènes mécaniues se passant dans l'oreille interne, J. de phys. **9**:185-94, 1938.

5. von Békésy, G.: Zur Theories des Hörens: Die Schwigungsform der Basilarmembran, Phys. Ztschr. **29**:793-810, 1928.

6. von Békésy, G.: Ueber den Knall und die Theorie des Hörens, Phys. Ztschr. **34**:577-582, 1933.

were extremely intense, the displacement would be great, and the eddies set up would tend to displace the fluid in the semicircular canals and cause the listener to tilt his head. This sudden involuntary moving of the head has been observed in response to excessively loud sounds.[7]

Both Békésy[5] and Reboul[4] suggested that the eddies occurring in the fluid as a result of the movement of the basilar membrane produce the distortion of the sensory cells requisite for their activation. This seems a rather unnecessary explanation. Why should it be necessary to ascribe the distorting force to the small hydraulic vortexes when the aural membrane to which the sensory cells are affixed is itself distorted? Furthermore, it is unlikely that these eddies occur at low intensities of stimulation. Why, then, ascribe to them the activating pressure at high intensities when the basilar membrane is itself undergoing greater amplitudes of vibration? However, it is probable that these vortexes when sufficiently strong contribute to the nonlinearity of the cochlear response.

NERVOUS MECHANISMS

It is obvious that the mechanics of the ear does not permit the activation of a single hair cell by a pure tone stimulus. The structure of the cochlea and the damping factor of the aural membrane are such that it is impossible for a sharply delimited area to vibrate in response to a given frequency while the remainder remains stationary; on the contrary, even with stimuli of low intensities a considerable section of the membrane must always be set in motion. However, it seems reasonable to assume that every pattern of basilar activity has at least one maximum and that the position of this maximum determines the pitch of the tone.

A given nerve fiber must be capable of activation by a wide range of tones, and the "local sign" on which the discrimination of frequency depends must often be associated with a large group of nerve fibers and a fairly considerable zone of the neuroepithelium. In fact, it has been shown that while each inner hair cell of Corti's organ is innervated by one or two fibers, each fiber making connection with one or two hair cells, the external cells have multiple innervation.[8]

The organ of Corti is innervated by the peri eral processes (dendrites) of the bipolar c of the spiral ganglion. Lorente de Nó[9] divid the fibers into two classes, according to t pathway they take: those which, after a sh course through the ganglion, run grouped in sm radial bundles directly into the organ of Co and those which run with the ganglion for co siderable distances, forming intraganglio spiral bundles.

This orderly arrangement is carried over a point to point projection in the primary acous nuclei.[10] The auditory fibers immediately entering the medulla oblongata divide i ascending and descending branches which t minate in two masses of gray matter, the dor and ventral nuclei, which are located in the res form body near the point where the latter tur back into the cerebellum. The ascending a descending branches are arranged in paral bundles in such a way that if the points of di sion are projected on a longitudinal plane th form an arc that is the caudal boundary of t ventral nucleus. This arc is a projection of t uncoiled organ of Corti in such a way that highest point corresponds to the apical and lowest to the basilar part of the ganglion. Lew and Kobrak,[11] using the Marchi degenerati technic, found that this projection is a topic representation of the cochlear spirals.

From the standpoint of the perception of sou the main auditory pathway appears to cons of fibers passing from the dorsal cochlear nuc through the lateral lemniscus to the medial geni ulate bodies and from there to the cortex. T spatial projection of the organ of Corti on t primary acoustic nucleus is carried over into t medial geniculate body and from there to t auditory area of the temporal cortex.

Ades and co-workers[12] studied the effect small circumscribed lesions in the medial geni ulate bodies on hearing in the cat. They foun that cats with lesions in corresponding area displayed the same distribution of hearing lo

7. von Békésy, G.: Ueber akustische Reizung des Vestibularapparats, Arch. f. d. ges. Physiol. **236**:59-76, 1935.

8. Lorente de Nó, R.: The Neural Mechanism of Hearing: Anatomy and Physiology; Sensory Endings in the Cochlea, Laryngoscope **47**:373-377, 1937; The Sensory Endings in the Cochlea, Tr. Am. Otol. Soc. **27**:86-90, 1937.

9. Lorente de Nó, R.: Anatomy of the Eigh Nerve: The Central Projection of the Nerve Endin of the Internal Ear, Laryngoscope **43**:1-38, 1933.

10. Lorente de Nó, R.: Anatomy of the Eigh Nerve: General Plan of Structure of the Primar Cochlear Nuclei, Laryngoscope **43**:327-350, 1933.

11. Lewy, F. H., and Kobrak, H.: The Neural Pro jection of the Cochlear Spirals on the Primary Acousti Centers, Arch. Neurol. & Psychiat. **35**:839-852 (April 1936.

12. (*a*) Ades, H. W.: Connections of the Media Geniculate Body in the Cat, Arch. Neurol. & Psychiat **45**:138-144 (Jan.) 1941. (*b*) Ades, H.; Mettler, F. A and Culler, E. A.: Effect of Lesions in the Media Geniculate Bodies upon Hearing in the Cat, Am. J Physiol. **125**:15-23, 1939.

that specific response areas could be localfor each tone tested. The nature of this ization was such that it appeared as if the ial geniculate body contained a projection of cochlear nucleus, each part of the latter being nected by more or less discrete bundles with esponding areas of the former.[12b]

Similar results were obtained by Coakley and er,[13] who studied the distribution of potenin the geniculate bodies for five frequencies timulation arranged in octave steps from to 2,000 cycles per second. The potentials erated by a tone were measured at one dred and twenty points arranged uniformly ughout the nuclei. A definite area of maxiresponse was obtained for each tone tested, when a map of these maxima was arranged rder of frequency they were found to conte a conical helix.

Using various technics, Waller,[14] Clarke,[15] lker,[16] Woollard and Harpman[17] and Ades Felder[18] established the presence of fiber nections between the medial geniculate body the temporal cortex. Several of these inigators found a distinctive spatial relationin the projection of these fibers on the ex, but an exact description of their distribuawaited the introduction of a special elecal technic by Woolsey and Walzl.[19]

These workers reported that the primary proion pathway terminates at the cortex n over-lapping "laminated" system in which funcally related groups of elements are oriented approxiely in a dorso-ventral direction through the auditory The focal zone of this system lies in a band at angles to the plane of lamination along a line ecting the focal area for the basal end of the cochwhich is situated at the upper end of the anterior sylvian sulcus, and that for the apex, which lies just behind the upper end of the posterior ectosylvian sulcus.

The tonotopic projections in the higher nerve centers may be taken as strong evidence that the ultimate discriminatory process must depend on the pattern of local signs which reach consciousness in the form of already resolved elements conducted from cochlea to cortex over systematically arranged fiber systems. Now the question arises, Why does the listener hear only one tone when, according to the mechanical behavior of the ear, a single frequency must activate a broad area of the basilar membrane and thus stimulate many nerve endings? Why does he not also hear several lesser tones a little higher and a little lower than the one sounded? Shower and Biddulph[20] from an experimental study of the minimal detectable changes in frequency concluded that at 40 decibels above threshold fifteen hundred different pitches are detectable throughout the audible range. Applying this figure in terms of distribution on the 30 mm. length of the basilar membrane, one finds that two tones stimulating areas 0.02 mm. apart on the neuroepithelium are distinguishable from each other. Therefore, there must be some factor by which a wide pattern of stimulation can be distinguished from another similar one which is displaced a fractional distance from the first. This factor can be adequately explained by the "principle of maximal stimulation," first described by Gray.[21]

Principle of Maximal Stimulation.—The principle is best explained by the analogy employed by Gray.[21]

> . . . If we take a pointed instrument, not so sharp however as to pierce the skin, and press it very gently against the tip of the finger, we are conscious of pressure at a point. If we press it harder the sensation of a pressure at a point remains, and we may press it so firmly as to render the tissues anaemic for an area of a centimeter in diameter, but still the sensation of pressure at a point persists. Now in this case many nerve terminals have been stimulated, and that strongly, and yet we are quite unconscious of the fact. In other words, although many nerve terminations have been stimulated, the mind pays no attention to these, but is only conscious of stimulation of that fiber or those fibers which have undergone a maximum degree of stimulation.

Gray uses the word "maximum" in its mathematical sense—by it he means a point of pressure surrounded by other points undergoing less pressure. It is possible therefore to have a pattern of maxima, that is, a number of points

Coakley, J. D., and Culler, E.: Distribution of itory Action-Potentials in the Medial Geniculate y of the Cat, Am. J. Physiol. **129**:335, 1940.

Waller, W. H.: Topographical Relations of Cor- Lesions to Thalamic Nuclei in the Albino Rat, omp. Neurol. **60**:237-269, 1934.

Clarke, W. E. L.: The Thalamic Connections of Temporal Lobe of the Brain in the Monkey, J. Anat. 47-464, 1936.

Walker, A. E.: The Projection of the Medial iculate Body to the Cerebral Cortex in the Macaque key, J. Anat. **71**:319-331, 1937.

Woollard, H. H., and Harpman, A.: The Cortical jection of the Medial Geniculate Body, J. Neurol. & chiat. **2**:35-44, 1939.

Ades, H. W., and Felder, R.: The Acoustic Area the Monkey (Macaca Mulatta), J. Neurophysiol. 9-54, 1942.

Woolsey, C. N., and Walzl, E. M.: Topical Proon of Nerve Fibers from Local Regions of the nlea to the Cerebral Cortex of the Cat, Bull. Johns kins Hosp. **71**:315-344, 1942; abstracted, Am. J. siol. **133**:P498, 1941.

20. Shower, E. G., and Biddulph, R.: Differential Pitch Sensitivity of the Ear, J. Acoust. Soc. America **3**:275-287, 1931.

21. Gray, A. A.: On a Modification of the Helmholtz Theory of Hearing, J. Anat. & Physiol. **34**:324-350, 1900.

of varying pressure, each separated from the other and each surrounded by an area of pressure less than its own.

The analogy drawn is a good one, as both senses involve a mechanical stimulus and as hearing may be considered a delicate form of touch, from which in fact it is embryologically and phylogenetically derived. If in the sense of touch the perceiving mind pays attention to the maximum point of stimulation only, it is probable that the same occurs in hearing. In other words, when a single tone is sounded, it is perceived by the mind as such, even though a surrounding area of the epithelium is also being stimulated.

LOCALIZATION OF TONES IN THE COCHLEA

It has been shown that the mechanical behavior of the ear and the spatial arrangement of central auditory components are such that it seems certain that the perception of sound must involve some form of spatial analysis on the basilar membrane. Many technics have been employed in the study of this problem, and with minor exceptions the evidence is strongly in favor of a fixed pattern of localization of pitch in the cochlea.

Embryologic Evidence.—McCrady and coworkers [22] made a careful developmental study of the auditory apparatus of the opossum. They found that the nervous system is complete for about a week before hearing is possible and that this function seems to await not only the appearance of Corti's organ but the last subtle steps in its differentiation.

In the opossum the development of the sensory mechanism is not a simultaneous event but a slow process, about five sixths of which occurs after birth. Hearing begins on the fifteenth day and is at first limited to one frequency of approximately 1,300 cycles per second; at this stage the organ of Corti has reached mature development in only the second half of the first coil of the cochlea. Generally speaking, the differentiation of the cochlea begins near the basal end of the organ and then proceeds in both directions. Likewise, the range of hearing begins with rather high tones, then spreads to the upper and lower limits of the audible spectrum.

Evidence from the Application of Drugs.—Many chemical substances, including salicylic acid, cocaine, chloroform and strong saline solutions, have been found to impair the cochlear response and the ability to hear.[23] A syste study of the effect has been made by F and Forbes,[24] who investigated the actio calcium chloride, glycerin and quinine dih chloride applied to the round window. observed that the response to high tones i paired sooner and to a greater extent than to low tones. Histologic examination o cochleas subjected to these substances reve a picture identical with the progressive tone deafness of advancing age—the hair closest to the round window were the struc most damaged. This coincidence of high loss with local destruction of the hair ce the basal turn may be taken as evidence in port of the theory of localization of tones i cochlea. These results have been confir by Walzl.[25]

Clinical Evidence.—Clinical data are at circumstantial evidence. However, such dence, because of its essential relation to subject, should not be left out of a discus of this kind. Two types of pathologic hea which are commonly met in clinical pra are of special interest:

1. Nerve versus conductive deafness. well known that types of deafness referabl injury of the auditory nerve or center ten exhibit tone gaps and islands in the upper ra whereas conductive types generally show a uniform loss. It is impossible to explain t peculiarities without recourse to some form spatial analysis in the auditory end organ.

By histologic studies of 79 ears giving au grams with abrupt high tone losses Crowe, G and Polvogt [26] conclusively showed that gaps are correlated with pathologic change

22. McCrady, E., Jr.; Wever, E. G., and Bray, C. W.: The Development of Hearing in the Opossum, J. Exper. Zool. **75**:503-517, 1937. McCrady, E.: Tone Localization in the Cochlea, Ann. Otol., Rhin. & Laryng. **44**:778-782, 1935.

23. Adrian, E. D.; Brank, D. W., and Phillips, The Nervous Origin of the Wever and Bray E J. Physiol. **73**:2P-3P, 1931. Hallpike, C. S., Rawdon-Smith, A. F.: The Helmholtz Reso Theory of Hearing, Nature, London **133**:614, Guttman, J.: Electrical Disturbances in the Co Produced by Sound, Laryngoscope **43**:983-985, Davis, H.; Derbyshire, A. J.; Lurie, M. H., and S L. J.: The Electric Response of the Cochlea, A Physiol. **107**:311-332, 1934.

24. Fowler, E. P., Jr., and Forbes, T. W.: (*a*) E of Certain Agents on Cochlear Effect and Hea Proc. Soc. Exper. Biol. & Med. **32**:827-829, 1 (*b*) Depression in Order of Frequency of the Elect Cochlear Response of Cats, Am. J. Physiol. **117**:2 1936; (*c*) End-Organ Deafness in Dogs Due to Application of Certain Chemicals to the Round-Win Membrane, Ann. Otol., Rhin. & Laryng. **45**:859 1936.

25. Walzl, E. M.: The Effect of Chemicals on C lear Potentials, Am. J. Physiol. **125**:688-698, 1939.

26. Crowe, S. J.; Guild, S. R., and Polvogt, L. Observations on the Pathology of High Tone Deaf Bull. Johns Hopkins Hosp. **54**:315-379, 1934.

ll corresponding areas of the sensory mecha-
n. They made graphic reconstructions of
f the cochleas studied and compared each
its respective audiogram: The area of
onse to stimulation by a frequency of 8,192
es per second was found located approxi-
ely 5 mm. from the basal end of the cochlea;
area sensitive to 4,096 cycles per second,
more than 7.3 and less than 9.5 mm. from the
, and the area sensitive to 2,048 cycles, more
n 9.5 and less than 12 mm. from the base.
se results have been verified in a similar
dy conducted by Oda,[27] and the areas of
lized response are in close agreement with
se obtained by Ciocco [28] and by Steinberg [29]
g as a method statistical analysis of the histo-
ic and audiometric data obtained in several
ndred cases of nerve deafness.

. Stimulation deafness. Kemp [30] in a critical
iew of the experiments on the problem of deaf-
s due to overstimulation came to the conclu-
n that the diversity of results obtained by
ferent experimenters using this technic is due
variation of the intensity-duration factor em-
yed. Some investigators [31] found losses for
es of the exposure frequency only; others
nd that protracted exposure to loud tones
uces an almost horizontal subsidence in audi-
y acuity throughout an extensive region of
audible range.[32] Still others [33] found no
iceable depression of the response to the
stimulating frequency or to any frequency in that region of the spectrum.

The failure of some experimenters to obtain specific losses, and of one group to obtain any loss whatsoever, is easily explained by certain factors in the theory of cochlear dynamics outlined in this paper.

It has been shown that greater amplitudes of stimulation result in greater amplitudes of vibration and a consequent spread of excitation on the basilar membrane. Thus when the intensity factor is of sufficient magnitude to damage the organ, relatively large areas of the epithelium will be involved.

The results of the group [33] who found no noticeable changes as a result of intense stimulation may be explained on the basis that the intensity-duration factor employed was too small and that the continuous sounds which they used have since been shown to be not nearly as effective as intermittent ones.

Evidence from Cochlear Microphonics.—The validity of treating the cochlear response as an index of peripheral auditory function has been considered elsewhere.[34] Suffice it to say that the evidence points to the hair cells of Corti's organ as the origin of cochlear potentials.

Hallpike and Rawdon-Smith [35] reported an experiment in which they made minute drill holes in the cochlear wall, filled the holes with mercury and placed an electrode in contact with the metal. They found that the lower frequencies were transmitted with greater intensity near the apex than at the base and vice versa.

Culler and co-workers [36] extended this work, using guinea pigs, and obtained specific results. The guinea pig ear is particularly suited to this type of experimental work in that the cochlea projects from the petrous bone and is not embedded in it as in man. Culler exposed the organ by cutting through the bulla from the ventral aspect and applied short lengths of sharp tungsten wire to twenty-five carefully localized points on the cochlear wall. Using an amplifier

27. Oda, D.: Observations on the Pathology of Impaired Hearing for Low Tones, Laryngoscope **48**:765-, 1938.

28. Ciocco, A.: A Statistical Approach to the Problem of Tone Localization in the Human Cochlea, Human ol. **6**:714-721, 1934; Observations on the Hearing of 80 Individuals: A Biometric Study, Laryngoscope 837-856, 1932.

29. Steinberg, J. C.: Positions of Stimulation in the chlea by Pure Tones, J. Acoust. Soc. America **8**: 5-180, 1937.

30. Kemp, E. H.: A Critical Review of Experiments the Problem of Stimulation Deafness, Psychol. Bull. :325-340, 1935.

31. Upton, M.: Functional Disturbances of Hearing Guinea Pigs After Long Exposure to an Intense ne, J. Gen. Psychol. **2**:397-412, 1929. Davis, H.; rbyshire, A. J.; Kemp, E. H.; Lurie, M. H., and ton, M.: Functional and Histological Changes in the chlea of the Guinea-Pig Resulting from Prolonged mulation, ibid. **12**:251-278, 1935. Guild, S. R.: War afness and Its Prevention—Report of the Labyrinths the Animals Used in Testing Preventive Measures, Lab. & Clin. Med. **4**:153-180, 1919.

32. Horton, G. P.: The Effect of Intense and Prolonged Acoustical Stimulation on the Auditory Sensitivity of Guinea Pigs, J. Comp. Psychol. **18**:405-418, 34. Finch, G., and Culler, E.: Effects of Protracted posure to a Loud Tone, Science **80**:41-42, 1934.

33. Wever, E. G.; Bray, C. W., and Horton, G. P.: e Problem of Stimulation Deafness as Studied by ditory Nerve Technique, Science **80**:18-19, 1934.

34. Kellaway, P.: Cochlear Microphonics: A Critical Review, Arch. Otolaryng. **39**:203-210 (March) 1944.

35. Hallpike, C. S., and Rawdon-Smith, A. F.: The Wever and Bray Phenomenon: A Summary of the Data Concerning the Origin of the Cochlear Effect, Ann. Otol., Rhin. & Laryng. **46**:976-990, 1937; The Wever and Bray Phenomenon: A Study of the Electrical Response in the Cochlea with Especial Reference to Its Origin, J. Physiol. **81**:395-408, 1934.

36. Culler, E. A.: An Experimental Study of Tonal Localization in the Cochlea of the Guinea Pig, Ann. Otol., Rhin. & Laryng. **44**:809-815, 1935. Culler, E.; Coakley, J. D.; Lowy, K., and Gross, M.: A Revised Frequency Map of the Guinea Pig Cochlea, Am. J. Psychol. **56**:475-500, 1943.

and a sharply tuned thermionic voltmeter, he measured the response of each point to each of twenty tones ranging from 125 to 7,000 cycles per second. He found that each point tested would respond maximally to a short range of frequencies, which means that each frequency has its own focus of response within the cochlea. These foci are so arranged that the organ is graduated in response to frequencies from base to apex. The cochlear map which Culler constructed from his data coincides, within the range of experimental error, with those obtained by other investigators.[37]

Evidence from the Effects of Masking.—When a person is surrounded by noise, his ability to hear other sounds is decreased—the noise is said to produce a masking effect. Fletcher [38] constructed a map of the positions of maximal response to pure tones from data derived from two sets of calculations, the width of the band of frequencies that a noise must contain in order to mask a pure tone, and the ratio of the intensity of the masking sound to that of the masked sound. The tonotopic arrangement of Fletcher's map agrees with that of Culler within the accuracy of the latter's method.

Surgical Evidence.—In my opinion surgical evidence when considered alone is invalid; the cochlea is obviously not normal once it has been drilled, scorched or otherwise injured. The failure of some investigators [39] to obtain discrete losses with supposedly localized surgical attentions can be explained on the basis that tissues other than those in the specific region of the operation may have been traumatized with consequent changes in the mechanical characteristics of the auditory apparatus. Even when a postmortem histologic examination is made, it is extremely difficult to evaluate the structural damage and to differentiate between functionally normal and abnormal cells.

On the other hand, the success of s workers [40] in obtaining specific losses localized lesions can be explained only by possibility that the technics employed succ fully produced circumscribed regions of dest tion in Corti's organ. Recently Walzl and B ley [40b] described such a technic: With a s dental burr they removed the bone over a lected part of the spiral ligament, which further loosened by gentle pressure with a b needle. This procedure causes the basilar m brane in this restricted area to bend and organ of Corti on it to be crushed or dislod

Using this technic they clearly showed each region of the cochlea responds optimall a specific frequency. Of special significanc their finding that in none of the operations there a complete loss for any tone, even tho subsequent histologic examination showed the organ of Corti was completely destroyed the site of operation. This is a restatement empiric terms of the principle of maxi stimulation: That is, as a sound increases intensity regions of the neuroepithelium ot than the one of optimal response also bec stimulated; the sensation of pitch, howe remains unchanged.

THE MECHANISM RESPONSIBLE FOR THE EXCITATION OF THE AUDITORY NERVE

It has been suggested that the cochlear pot tials arising in response to acoustic stimuli the agent responsible for the excitation of auditory nerve. However, while it is true t nerve potentials are never demonstrable in absence of cochlear microphonic, certain f tors render the hypothesis untenable.

The response to a change of phase of degrees in an electrical stimulus applied to ear is a brief silent period.[41] This silent peri termed "the phase change beat," cannot be p duced by any process occurring in the audito nerve or in the central nervous system; he the electrical stimulus must not directly exc the eighth nerve but instead must set up so kind of intermediate process in the inner e probably a transduction of electrical into mecha ical energy. It is extremely unlikely, therefo that cochlear potentials are responsible for t excitation of the auditory nerve.

37. Kemp, E. H., and Johnston, P.: Localization of Response in the Cochlea as Determined by Electrical Recording, Science **90**:405, 1939.

38. Fletcher, H.: The Mechanism of Hearing as Revealed Through Experiment on the Masking Effect of Thermal Noise, Proc. Nat. Acad. Sc. **24**:265-274, 1938; Auditory Patterns, Rev. Mod. Physics **12**:47-49, 1940.

39. van Gilse, P. H. G.: Expérimentations suivant la méthode de Wever et Bray après lésion de la cochlée, Acta oto-laryng. **20**:23-31, 1934. Bast, T. H., and Eyster, J. A. E.: Tone Localization in the Cochlea, Ann. Otol., Rhin. & Laryng. **44**:792-803, 1935. Dubner, H.; Gerard, R. W., and Kobrak, H.: Objective Measures of Hearing, Am. J. Physiol. **116**:38, 1936. Kobrak, H. G.; Lindsay, J. R.; Perlman, H. B., and Dubner, H.: Effect of Limited Cochlear Lesions on Cochlear Potentials and Middle Ear Muscle Reflexes, Arch. Otolaryng. **27**:59-66 (Jan.) 1938.

40. (*a*) Stevens, S. S.; Davis, H., and Lurie, M. H. The Localization of Pitch Perception on the Basil Membrane, J. Gen. Psychol. **13**:297-315, 1935. (Walzl, E. M., and Bordley, J. E.: The Effect of Sm Lesions of the Organ of Corti on Cochlear Potenti Am. J. Physiol. **135**:351-360, 1942.

41. Kellaway, P.: The Electrophonic Response Phase Reversal, J. Neurophysiol. **7**:227-230, 1944.

Several other factors cannot be accounted for the hypothesis of electrical excitation. First, fatigue does not vary with frequency the extent demanded by a simple theory of trical stimulation.[42] Second, electrical con- tion time in organic tissue is too fast to count for the long latency of approximately 0 millisecond [43] exhibited by the impulses the auditory nerve. Third, it has been own [44] that in the absence of the cochlea ect stimulation of the auditory nerve endings h alternating currents of various frequencies duces the sensation of noise—frequency is discriminated. Fourth, if cochlear micro- nics were the agent of nerve stimulation, mulation would be continuous as long as they re generated; however, nerve impulses are iated during only one phase of the cochlear crophonic. This particular phase is asso- ted with outward movement of the stapes, times at which the round window is passing m electrical negativity to electrical positivity. The latency of the first wave of the action tential measured from the negative peak of microphonic, whether the microphonic is positive or negative polarity, is 0.80 milli- ond. However, the latency of the first wave the action potential, if it is positive, measured m the positive of the microphonic is 0.60 illisecond. Hence, if the first major movement the stapes is inward, the first electrical change from positive to negative and no impulses pear in the auditory nerve until the negative positive change associated with outward move- ent of the stapes ensues.

Chemical Mediation.—During the past few ars many experiments have been performed hich indicate that there is a chemical transmis- n of nervous effects to the autonomic effec- rs and the skeletal musculature.[45] In the light this evidence Derbyshire and Davis [46] sug- sted that stimulation of the cochlea results in liberation of a chemical mediator which initiates the subsequent impulses in the auditory nerve.

The factors which contradict the theory of cochlear microphonics as the stimulating mechanism tend to support the theory of chemical mediation: For example, the long latency of the nerve impulses is easily explained in a theory of chemical mediation by the period required for diffusion and for utilization. Further, it is quite possible that the production or the liberation of the chemical mediator may be the result of the same deformation of the hair-cells which piezo-electrically generates the cochlear potentials.[34] If this is so, it is quite reasonable to assume that traction induced by outward movement of the stapes results in liberation or production of a chemical mediator, while pressure resulting from inward movement of the stapes does not. This would account for the "stimulating phase" of the cochlear microphonic.

It has been pointed out that "auditory fatigue" does not vary with frequency to the extent demanded of a simple theory of electrical stimulation. However, auditory fatigue is not a true fatigue in that it does not represent a state of exhaustion but a state akin to temporary damage of the responding mechanism. In fact, because it emphasizes an analogy to mechanical processes such as the magnetization and demagnetization of iron, Stevens and Davis gave the name "hysteresis" to the phenomenon. The sensory mechanism and magnetized iron are similar in that following excessive activity both have to be restored to their original state before their original response curves can be retraced (hysteretic loss). This effect is a result of overload and is a function of intensity and duration, not of the frequency of the stimulus, and therefore easily explained on the basis of chemical mediation.

If the chemical mediator is produced by the hair cells themselves, as it has been shown for the preganglionic nerve endings of the sympathetic ganglions,[47] "temporary damage" to these cells would necessarily result in inhibition of the synthesis, and the cells would have to return to their normal state before functional normalcy could be achieved.

Further evidence in support of the theory of chemical mediation is found in the work of Fowler and Forbes [24c] and Walzl,[25] who recorded the cochlear responses after various chemical agents had been applied to the round window membrane in cats anesthetized with a barbiturate. It was found that these substances produced a

42. Pattie, F. A., Jr.: An Experimental Study of atigue in the Auditory Mechanism, Am. J. Psychol. :39, 1927.

43. Derbyshire, A. J., and Davis, H.: The Action otential of the Auditory Nerve, Am. J. Physiol. **113**: 6-504, 1935.

44. Andreev, A. M.; Gersuni, G. V., and Volokhov, A.: On the Electrical Excitability of the Human ar: On the Effect of Alternating Currents on the ffected Auditory Apparatus, J. Physiol., U. S. S. R. :250-265, 1935.

45. Cannon, W. B.: The Arguments for Chemical ediation of Nerve Impulses, Science **90**:521, 1939. ale, H. H., and Feldberg, W.: Chemical Transmis- on at Motor Nerve Endings in Voluntary Muscle, J. hysiol. **81**:39, 1934.

46. Derbyshire, A. J., and Davis, H.: The Probable echanism for Stimulation of the Auditory Nerve by e Organ of Corti, Am. J. Physiol. **113**:35, 1935.

47. Feldberg, W.: Synthesis of Acetylcholine in Sympathetic Ganglia and in Cholinergic Nerves, J. Physiol. **101**:432-445, 1943.

loss which appeared first in the higher tones and then progressed regularly to the lower tones and that the rapidity and the degree of loss were proportional to the concentrations used. The experimenters interpreted their results as due to interference with a chemical mediator and its access to the nerve endings by an increase or a reduction of cell permeabilities brought about by the progressive encroachment of the chemical concentrations employed.

The question as to whether a chemical mediator could appear and disappear rapidly enough to initiate the necessary impulses, up to 400 per second,[47] has been answered in some recent experiments. It has been shown that the enzyme cholinesterase is located on the neuronal surface—a factor which lends itself to the rapid inactivation of acetylcholine. This is not to suggest that acetylcholine is the chemical mediator responsible for the initiation of impulses in the eighth nerve, but it can be taken as supporting evidence for the existence of a similar agent in the mechanism of cochlea to nerve mediation.

CONCLUSION

In conclusion I should like to make a brief reference to a paper recently published by Galambos and Davis.[48] These workers isolated and recorded the response from single fib of the auditory division of the eighth ner They found that at minimal intensity each fi responds only to a narrow band of frequenc being unaffected by all others. It is clear, the fore, that a pure tone stimulus sets into mot a particular and restricted area of the basi membrane.

As the intensity of the stimulus is increas more and more fibers become active, and the r of discharge in individual fibers is accelerat Increase in intensity must therefore involv gradual and systematic spread of excitation the basilar membrane. One knows from s jective experience that a tone is heard at ab the same pitch at threshold as it is at decibels; hence this spread must occur with any significant modification of the percei sound.

These observations, made as they were single fibers of the eighth nerve, provide a pict of the process responsible for the transmiss of spatial patterns from the cochlea to the hig nerve centers and incidentally explain the r son for the fact that a change of gradient fr one point to another tends to stand out pro inently in sensation. The missing link betwe the peripheral analyzer and the tonatopic rangement of the acoustic nuclei is thus suppli

McGill University.

48. Galambos, R., and Davis, H.: The Response of Single Auditory Nerve Fibers to Acoustic Stimulation, J. Neurophysiol. **6**:39-57, 1943.

CONGENITAL ATRESIA OF THE POSTERIOR NARES

DESCRIPTIONS OF TECHNICS USED IN MEETING THE OPERATIVE DIFFICULTIES AND REPORT OF A CASE

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tresia of the posterior nares is a condition racterized by closure of one or both posterior nae. The obstructing partition may be er complete or incomplete and may be mem-nous, membrano-osseous or osseous. It is atresia in the true sense of the word in that robably occurs because of the failure of nor-lly occurring embryonic structures to dis-ear.

Choanal atresia, although a rare anomaly, has n described in the literature for over a hun-d years. It was first portrayed in 1829 by o,[1] who observed it at autopsy. In 1853, mert[2] diagnosed and successfully operated it in a 7 year old boy. In 1859, Luschka[3] nd it in a newborn dead child. In 1876, ts[4] reported a case in which it was discovered rtly after birth. Hubbel,[5] in 1886, reviewed literature and listed 17 recorded cases of genital choanal atresia to which he added 1. rke,[6] in 1898, found 21 cases, while in 1904 hmiegelow[7] reported the total as 61 cases, in majority of which the atretic structure was eous in nature. Fraser[8] estimated the num-of cases to be 117 by 1910. According to elli,[9] 220 cases had been reported by the end of 1940. Up to the present time, in a review of the available literature I have been able to account for approximately 230 cases. It is to be noted that an ever increasing number of cases has been reported recently. With the hope of stimulating further interest in this anomaly, I am reporting an additional case.

Statistics indicating the frequency of this condition have been published. According to Stewart,[10] only 6 cases of unilateral atresia were recorded in the ear, nose and throat department of the Royal Infirmary of Edinburgh, Scotland, during the period from 1907 to 1926. In the Massachusetts Eye and Ear Infirmary, Kazanjian[11] reported that among 62,228 patients examined during the period from 1922 to 1938 there were 10 presenting choanal atresia. Of these 10, 4 had right-sided, 3 left-sided and 3 bilateral atresia. Anderson[12] reported 6 cases observed in the Mayo Clinic from 1903 to 1937; in 1 the atresia was bilateral. In a subsequent study in the same clinic Pastore and Williams[13] recorded a total of 12 cases by 1939. In 4 of these the atresia was bilateral, in 5 right sided and in 3 left sided. Unfortunately, sufficient statistics are not available in the literature to enable one to ascertain the frequency of choanal atresia or the proportion of cases in which it is unilateral to those in which it is bilateral.

In review, the boundaries of the definitive choana are as follows: medially lie the posterior border of the vomer and the nasal crest of the palatal bone; above are the ala of the vomer and the body of the sphenoid bone; the lateral boundary is made up of the medial plate of the pterygoid process of the sphenoid bone along

1. Otto, A. W.: A Compendium of Human and parative Anatomy, translated by J. F. South, Lon-, B. Fellowes, 1831; cited by White,[15] by Cinelli[9] by Morgenstern.[34]
2. Emmert, cited by von Schroetter,[38] by Cinelli[9] and Morgenstern.[34]
3. Luschka, H.: Ueber angeborene Atresie der anen, Arch. f. path. Anat. **18**:168, 1860; cited by ite[15] and by Cinelli.[9]
4. Betts, quoted by von Schroetter;[38] cited by ver.[24b]
5. Hubbel, A. A.: Congenital Occlusion of the terior Nares, Buffalo M. & S. J. **26**:5, 1886.
6. Clarke, J. P.: Complete Congenital Occlusion of Posterior Nares, Boston M. & S. J. **38**:171, 1898.
7. Schmiegelow: Case of Congential Atresia of the anae, abstracted, Ann. Otol., Rhin. & Laryng. **13**: (March) 1904.
8. Fraser, J. S.: Congenital Atresia of the Choanae, t. M. J. **2**:601, 1910; cited by White.[15]
9. Cinelli, A. A.: Nasal Atresias: A Surgical Cri-e, Ann. Otol., Rhin. & Laryng. **49**:912 (Dec.) 1940. s article includes an excellent bibliography.
10. Stewart, J. P.: Congenital Atresia of Posterior Nares, Arch. Otolaryng. **13**:570 (April) 1931.
11. Kazanjian, V. H.: The Treatment of Congenital Atresia of the Choanae, Ann. Otol., Rhin. & Laryng. **51**:704-711 (Sept.) 1942.
12. Anderson, C. M.: Congenital Occlusion of the Choana, J. A. M. A. **109**:1788 (Nov. 27) 1937.
13. Pastore, P. N., and Williams, H. L.: Congenital Occlusion of Nasal Choanae: Brief Review of Twelve Cases, Proc. Staff Meet., Mayo Clin. **14**:625 (Oct. 4) 1939.

with the perpendicular plate of the palatal bone; the inferior boundary is the horizontal plate of the palatal bone.

The classification of cases of congenital atresia is simple, according to whether the atresia is unilateral or bilateral, complete or incomplete. They are further classified according to whether the occluding partition is membranous, osseous or mixed (i. e., membrano-osseous). Richardson,[14] White [15] and others [16] pointed out that the membranous partition is attached to the most posterior part of the choanal boundary (probably the remains of the buccopharyngeal membrane). If the obstruction is bony in substance, it is attached 1 to 2 mm. within the nasal cavity (probably the remains of the bucconasal membrane). Lebensohn [17] stated that in 90 per cent of cases of atresia the obstruction is bony. It has been shown that in the same patient the thickness may vary from a few millimeters to more than 12 mm.[18] The central portion is usually thinner, and it may be membranous. If it is, the membrane appears to be dimpled when examined by means of a pharyngeal mirror.

In the past, many ideas of the cause of this condition have been recorded. White,[15] Luschka [3] and Schwendt [19] expressed the belief that choanal atresia results from proliferation of the palate bone, both upward and backward. Kahler [20] and Kundrat [21] stated that a more likely cause was an extension inward of the vertical plate of the palate bone. Hapmann [22] maintained that in order for atresia to develop there must first be marked stenosis of the choanae. Bitot [23] claimed that the bony closure is always caused by the development of a new and separate b In spite of these early ideas, the modern t of opinion is that choanal atresia is a deve mental anomaly of a slightly different na

The nasal organ begins as an olfactory which gradually enlarges to form a blind po The latter is called the nasal sac. As the n sac enlarges, its dorsal and inferior portion proximate the pharynx.[24] Hence, the nasal thelium on the one hand comes in contact the pharyngeal epithelium on the other. T two layers may be separated by a layer of m dermal tissue of varying thickness. The pa tion thus formed, which separates the nasal ca from the primitive pharynx, is called the bu nasal membrane. The mesoderm is gradu absorbed and in 35 to 38 day embryos the m brane becomes so attenuated that rupture sho ensues.[25] This forms the primitive choa which are separated from each other by primitive septum. Failure of the membran rupture leads to atresia of the choanae. amount of mesodermal tissue which rem between the two layers will determine whe the obstruction is to be membranous or bon nature.

Anterior to the primitive choanae lies primitive palate, which gradually grows back and by union of the two palatal processes fo the secondary palate.[24b] The septum grows ba ward and down to join the palate and so can the primitive choanae dorsally until approxi tion with the cephalic portion of the phar is established. Earlier, embryologically, stomodeum or oral cavity is separated from foregut or pharynx by means of the bu pharyngeal membrane. This membrane usually ruptured and disappeared by the t the palate has formed and reached that a As pointed out by Colver [24b] and again by Sh art,[10] that portion of the buccopharyngeal m

14. Richardson, C. W.: Congenital Occlusion of the Post-Nasal Orifices, with Report of a Case, Tr. Am. Laryng. A. **35**:226, 1913.

15. White, L. E.: An Operation for Bony Occlusion of the Posterior Nares, Laryngoscope **28**:571, 1918.

16. Grove, W. E.: Choanal Atresia and Sinus Infection, Arch. Otolaryng. **6**:237 (Sept.) 1927.

17. Lebensohn, J. E.: Congenital Atresia of Postnasal Orifices, Ann. Otol., Rhin. & Laryng. **32**:1128 (Dec.) 1923.

18. Garretson, W. T.: Congenital Occlusion of Choanae, with Report of Two Cases, Laryngoscope **37**: 262 (April) 1927.

19. Schwendt, A.: Ein Fall von angeborenem doppelseitigen knöchernen Verschluss der Choanen; Heilung durch Galvanocaustik, Monatschr. f. Ohrenh. **31**:105, 1897; cited by White.[15]

20. Kahler, O.: Ueber kongenitale knöcherne Choanalatresie; ein Beitrag zur Frage des hohen Gaumens, Monatschr. f. Ohrenh. **43**:41-68, 1909; cited by White.[15]

21. Kundrat, H.: Die Arhinencephalie als typische Art von Missbildung, Graz, Leuschner & Lubensky, 1882; cited by White.[15]

22. Hapmann: Ueber Congenitale, cited by White; [15] Boston M. & S. J. **180**:153 (Feb. 6) 1919.

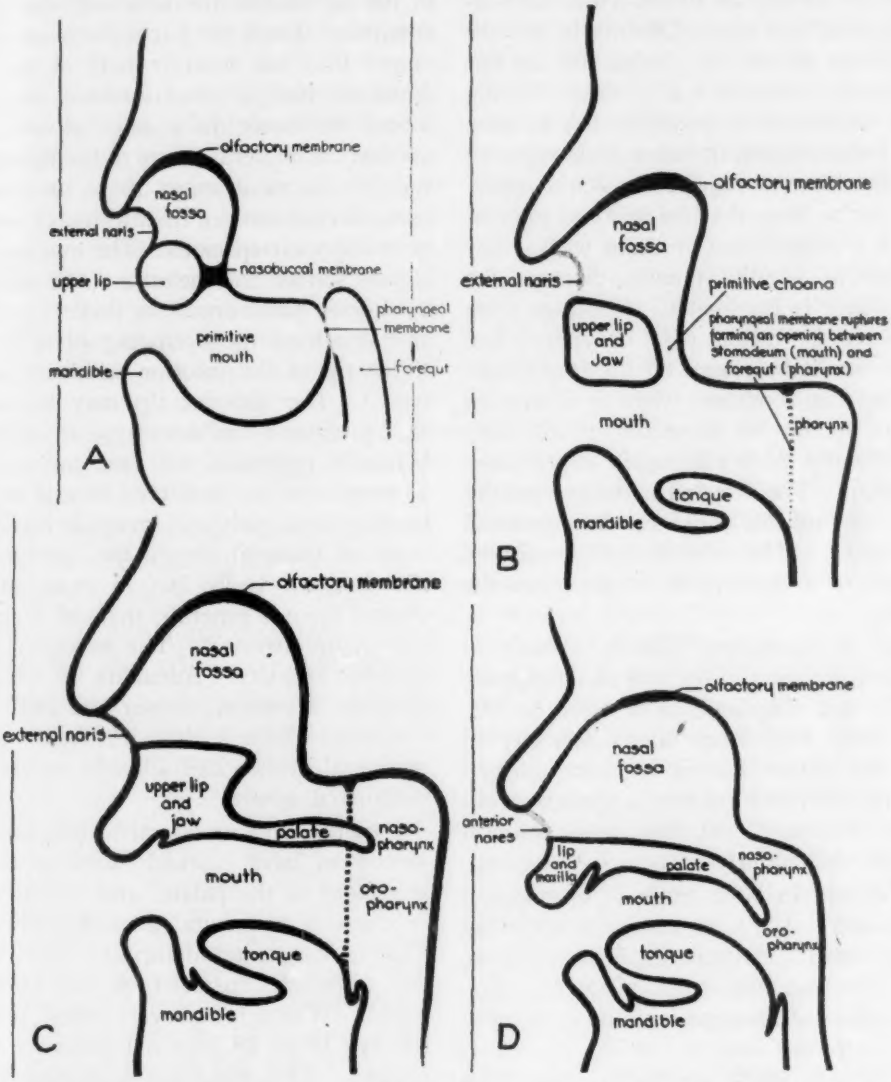
23. Bitot: Atrésie ou obturation congénitale des orifices postérieures des fosses nasales, Arch. de tocol. **3**:544 (Sept.) 1876; cited by Schwartz and Isaacs.[26]

24. (*a*) Hochstetter, F.: Ueber die Bildung der neren Nasengänge oder primitiven Choanen, Verh d. anat. Gesellsch. **145**:151, 1891; cited by White [15] by Cinelli.[9] (*b*) Colver, B. M.: Congenital Cho Atresia: Two Cases of Complete Bilateral Obstruct Ann. Otol., Rhin. & Laryng. **46**:358 (June) 1937. T article has an excellent bibliography. (*c*) Keibel, by White.[15] (*d*) Tiemann, H.: Ueber die Bildung primitiven Choanen bei Säugetieren, Wurzburg, cited by White [15] and by Cinelli.[9]

25. Schaeffer, J. P.: The Various Types of genital Atresia of the Nose and Their Genetic Inter tation, in the Nose, Paranasal Sinuses, Nasolacr Passageways, and Olfactory Organ in Man: A Ge Developmental, and Anatomico-Physiological Consi ation, Philadelphia, P. Blakiston's Son & Co., 1920 7-10; cited by Morgenstern.[34] Schaeffer, J. P.: Var Types of Congenital Atresias of the Nose and T Genetic Interpretation, Tr. Am. Laryng. A. 56: 1943.

e in the region above the level of the palate it persist and thus be the cause of choanal sia. As already mentioned, the amount of odermal tissue remaining between the two helial layers will determine the nature of obstruction.

congenital choanal atresia is due in all cases a persisting developmental membrane, the vertical and horizontal palatal processes. These bones are laid down in cartilage. Therefore, it seems plausible that cartilage appearing in the bone of a congenital choanal atretic structure might well originate from this source. I am in agreement with Stewart [10] that these three theories must be jointly considered in order to explain the findings in all cases.



ig. 1.—Schematic representations of the embryologic development of the nasal, oral and pharyngeal cavities, the choanae.
hese four illustrations are used with the permission of Dr. Benton C. Colver.[24b]

lting bone should be membranous and should contain cartilage. It has been shown, how-, by histologic examination [10] of bony frag-ts removed at operation and post mortem [26] islands of cartilage do occur. This presents third possibility, a medial overgrowth of the

It is unlikely that choanal atresia is hereditary. However, 2 living members of one family and possibly a third member, dying in infancy, had the anomaly, according to Stewart.[10] Phelps [27] cited a family in which the mother, her 2 sisters, her 2 daughters and a son were affected. Nevertheless, from evidence in the literature it is

Schwartz, A. A., and Isaacs, H. J.: Congenital sia of the Posterior Nares: Report of Two Cases, Otolaryng. **35**:603 (April) 1942.

27. Phelps, K. A.: Congenital Occlusion of Choanae, Ann. Otol., Rhin. & Laryng. **35**:143 (March) 1926.

doubtful that heredity plays an important part in the production of choanal atresia.

In the newly born, choanal atresia presents an emergency which should be recognized by the obstetrician, by the pediatrician and certainly by the otolaryngologist. It is generally agreed that at least in some cases so-called asphyxia neonatorum has been caused by bilateral atresia. Richardson [14] described an infant with this condition. The child had great difficulty in breathing; when it was at rest the cheeks and the lips were indrawn, and cyanosis was marked. Crying relieved the symptoms temporarily, but as soon as the child became quiet, the same cycle repeated itself. Such children require constant supervision in order to keep the lips apart to prevent asphyxiation. Within two or three weeks they usually learn to breathe quietly through the mouth. Nursing is impossible. Feedings must be administered by means of a dropper. Too much stress cannot be placed on the importance of diagnosing this condition when it is present at birth. It should be suspected in all cases in which difficulty of breathing is experienced by the newborn. The affected nares are usually filled with sticky mucus, which can be expressed from the nostril. The diagnosis is confirmed by the failure of a blunt probe to pass into the nasopharynx.

Unilateral or incomplete bilateral atresia in an infant does not usually become an emergency and often is not diagnosed until later in life. The infant may experience slight difficulty in nursing if the patent nostril becomes clogged but otherwise does not present a serious problem. Some writers [28] feel that such children are apt to be undernourished.

Choanal atresia in later years is a condition easily diagnosed. There is generally a history of difficulty with nutrition in infancy, more marked if the condition was bilateral. The patient complains of absolute inability to breathe through the affected nostril. If the atresia is bilateral he is naturally a mouth-breather. The upper teeth, especially the incisors, are irregular. The palate is usually high, and if the atresia is unilateral, asymmetric, although Asherton [29] reported a case in which no deformity of the hard palate was noticed. Anosmia is usually present, although Schwartz and Isaacs [26] reported 2 cases of unilateral atresia without loss of the sense of smell on the affected side. Many pat with atresia have a diminished sense of t

The floor of the obstructed nostril is al covered by an accumulation of tenacious, t sticky albuminous mucus. Some [30] have cla that this secretion has a distinctly bluish The older patient learns to remove this disch by pressing on the ala of the nose. Excori of the skin about the nose and the upper l common. Tears are particularly annoying; empty into the anterior part of the nose, when the head is tilted forward, run out fr Vocal resonance is usually altered when anomaly is bilateral, being of the rhinolalia cl type.[10] In most cases there are atrophy underdevelopment of the turbinates, and the n cavity appears spacious. The mucous memb is pale, sodden and inelastic. The turbinates be shorter than normal, or they may extend and attach to the occluding plate.[16] The terior tip of the inferior turbinate may be sent.[17] The anterior tip may be swollen may present a mulberry type of degenerati White [15] reported the case of a man 53 years who had unilateral atresia with a hy trophied and polypoid mucous membrane. cases of bilateral atresia the septum is us not deviated badly but in cases of unila closure there is generally marked deviation t side of the atresia.[31] The nasopharynx ma atrophic and dry. Adenoids, as a rule, are present. However, Geiger and Roth [28] repo a case in which a child 4½ years of age unilateral atresia had adenoid tissue behind obstructed nostril.

Patients with unilateral atresia have been served to have marked facial asymmetry inequality of the palatal arch.[17] As is com in cases of congenital anomaly, more than type of congenital deformity may occur. lips, although separated, do not, as a rule, trude. White,[15] however, noted protrusio the lips in an 18 year old patient with bila closure. This condition improved after a cessful operation. The shape of the nose is generally abnormal, but Asherton [29] report case in which the nose was flat, with ma separation of the cartilages in the tip.

Sinus involvement has been reported in a few cases of choanal atresia. Accordin Grove,[16] however, the sinus on the obstru side is particularly susceptible to infection. reported a case of unilateral atresia in which

28. Geiger, C. W., and Roth, J. J.: Osseous Choanal Obstruction and Adenoid Tissue, Arch. Otolaryng. **15:** 441 (March) 1932.

29. Asherton, N.: Bilateral Congenital Occlusion of Posterior Choanae Due to Membranous Diaphragm, J. Laryng. & Otol. **45:**344 (May) 1930.

30. Kirby, J. C.: Cases of Post-Nasal Choanae formation by Bony Occlusion, Laryngoscope (Sept.) 1921. Lebensohn.[17]

31. Asherton.[29] White.[15]

um was involved and expressed the opinion the reason so few cases of this type were orted was that incomplete examinations were e. Dean [32] found that all children whom ad seen with choanal atresia had sinusitis. ertheless many competent observers have d the sinuses normal.[33] Morgenstern [34] re- ed a case with lack of development of the tal sinus on the side of the obstruction. I this observation is of no particular signifi- ce.

nvolvement of the ears is not generally found. ve [16] noted retraction and some thickening he tympanic membranes in 1 case, but the ring for watch tick and whispered voice ap- red normal. Bonham [35] reported a case with foration of both ears; the hearing, however, not markedly decreased. A case of unilateral sia with bilateral purulent otitis media was orted by Thomasson.[36] Most observers, how- , have not found pathologic involvement of ear to be a common complication.

he differential diagnosis is relatively simple. ncludes ruling out the following abnormali- [12]:

. Adenoids. (Morgenstern [34] stated that ade- ds are not found in early infancy.)

. Congenital postnasal polyps or tumor.

. Intranasal occlusion due to polyps, a bony a cartilaginous obstruction or a new growth.

. Cicatricial stenosis of the nasopharynx due (*a*) tonsillectomy, (*b*) tonsillectomy and ade- ectomy, (*c*) hereditary syphilis, (*d*) ac- ed syphilis, (*e*) diphtheria, (*f*) rhinoscle- a, (*g*) tuberculosis, (*h*) caustic burns, (*i*) terminate inflammatory processes, (*j*) non- ative trauma or (*k*) foreign body in the nose.

he literature abounds in reports of cases in ch the patient has been operated on for noids several times and even for nasal polyps h failure to obtain relief.[37] Confirmation of diagnosis is not difficult. The passing of a nt probe into the nostril with failure to reach nasopharynx is significant. Irrigation of the cted nostril with return of the entire flow lso significant. The nasopharyngoscope is seful aid. With adults and older children, palpation of the nasopharynx is important. If the patient is cooperative, perhaps the most useful examination is carried out with the post- nasal mirror. Finally, roentgen examination after the nostril has been filled with iodized oil clinches the diagnosis. The latter demonstrates beyond all doubt the location and the thickness of the occlusion.

Different types of treatment with many tech- nics are described throughout the available litera- ture. Because of the rarity of the condition, one man sees it in few if any patients in his life- time, and therefore a trial of all of the technics is impossible. For this reason, in its present status the treatment of choanal atresia is more or less confusing.

In 1853 Emmert [2] reported the first success- ful surgical procedure in which he broke down the occluding bone by means of a curved trochar. Electrocauterization was first successfully used by von Schroetter.[38] Following this, many types of chemical cauterization were employed without success. In 1886, Hubbel [15] used a hand drill, but the opening closed early and had to be oper- ated on again. He introduced the use of tin tubes 10 mm. in diameter to keep the openings patent during convalescence. The use of the chisel and curet to open an airway through the nasal and septal root was first advocated in 1908, by Uffenorde.[39] In 1913 Katz and co- workers [40] and in 1919 White [15] reported a new and important surgical procedure. They re- moved the bony occlusion by means of chisels, curets and biting forceps and completed the operation by using a rongeur to remove the posterior part of the vomer. Bourgeois and Leroux [41] reported in 1922 the first successful use of electrocoagulation as a complete operative procedure. Skin grafting was introduced in 1931 by Blair [42] as a means of preventing closure of the choana. A large split graft was used, which was wrapped around a rubber tube so that the

Dean, L. W.: Paranasal Sinus Disease in Infants Young Children, J. A. M. A. **85**:317 (Aug. 1) 1925. Asherton.[29] Kazanjian.[11]

Morgenstern, D. J.: Congenital Atresia of Post- l Orifices, Arch. Otolaryng. **31**:653 (April) 1940.

Bonham, W. L.: Congenital Choanal Occlusion, th. M. J. **35**:252 (March) 1942.

Thomasson, W. J.: Congenital Bony Occlusion e Right Nasal Choana, Laryngscope **25**:221 (April)

Grove.[16] Kirby.[30] Stewart.[10]

38. von Schroetter: Ueber angeborenen knöchernen Verschluss der Choanen, Monatschr. f. Ohrenh. **19**:97, 1885; cited by White,[15] by Cinelli [9] and by Morgen- stern.[34]

39. Uffenorde, W.: Ein Fall von Choanalatresie mit Demonstrationen, Ztschr. f. Laryng., Rhin., Otol. **1**:475 1908; cited by Cinelli.[9]

40. Katz, L.; Preysing, H., and Blumenfeld, F.: Handbuch der speziellen Chirurgie des Ohres und der oberen Luftwege, Leipzig, Curt Kabitzsch, 1911-1913, vol. 3, p. 432; cited by White [15] and by Cinelli.[9]

41. Bourgeois and Leroux, cited by Imperatori, C. J., and Burman, H. J.: Diseases of the Nose and Throat, for Practioners and Students, Philadelphia, J. B. Lip- pincott Company, 1935, p. 638.

42. Blair, V. P.: Congenital Atresia or Obstruction of the Nasal Air Passages, Ann. Otol., Rhin. & Laryng. **40**:1021 (Dec.) 1931.

raw surface would be in contact with the choana. In 1938 Donnelly [43] repaired a unilateral defect using a full thickness graft.

The patients who are to be treated for choanal atresia naturally fall into two groups—newborn infants and older patients. Considerable controversy has arisen regarding the advisability of immediate operation on newborn infants. In 1913 Richardson [14] expressed the opinion that operation should be deferred until the second year if possible but that one should be prepared to operate immediately should the infant's condition become critical. Koch [44] operated on an 11 month old child successfully, taking one side at a time. Loeb [45] and later Lemere [46] advocated immediate operation on infants if the bone was not too thick. Lebensohn [17] and Geiger and Roth [28] express the belief that the optimum age is no later than 9 months, for after that period, they said, skeletal deformities of the face and the thorax might arise. Colver [24b] and Phelps [27] recommended early operation and claimed that the subsequent normal development of the child warrants the risk entailed. A child with unilateral atresia may never come to operation. One in whom the condition is bilateral, however, according to Cinelli,[9] requires expert pediatric care for two years and should then be operated on. He stated that in cases of membranous obstruction he prefers to break down the membrane early and, if necessary, to use electrocoagulation for membranous or osseomembranous obstructions in infants and children. If the atresic structure is bony, he prefers surgical removal, followed by electrocoagulation of the edges either at once or at a later date.

I believe that with infants the type and the time of treatment depend on the particular case. Should atresia be found and the respiratory difficulty is of a degree to endanger life, immediate intervention is necessary. In cases in which the occluding structure is a membrane or thin bone, it should be broken down with a blunt instrument, followed shortly by electrocoagulation. If the occluding structure is thick and bony, it may be removed by whatever means the surgeon selects (drills, curets, chisels, trephine or some other instrument). Because it is impossible to achieve complete, adequate surgical removal in a young infant, it is advisable to follow up the first operation with a subsequent operation with electrocoagulation at a time when the general condition of the patient warrants further intervention.

In the case of an older child or an adult the character of the obstruction naturally will determine the necessary type of operative procedure. Many patients with unilateral atresia are not seen by the physician because the complaints are of insufficient magnitude to demand attention. Even the patients with bilateral atresia have been picked up simply on routine examination, as in the case reported in this article.

Early writers, such as Clarke [6] and Pfingst used an electric or a hand trephine to remove occluding bone by way of the nostril. Later Pfingst [47] and Katz [40] advocated making three to four drill holes through the atretic wall and enlarging the opening with a saw or a bone forceps. Many of the early operations were unsuccessful. The opening closed with cicatricial tissue. Katz,[40] White [15] and earlier perhaps MacKenty advocated removing the posterior quarter of the septum as the last stage in the operation. Richardson [14] and Stewart [10] preferred to do a complete submucous resection as the first step, freeing the mucoperichondrium from the septum, from the sphenoid bone and laterally from the occluding bone. This obstruction they removed, working between the layers of the septum, with chisels, a trephine, burrs and other instruments. Finally, the mucoperichondrium corresponding to the opening thus made was removed. To discourage the formation of scar tissue, the posterior third of the septal mucoperichondrium was removed with a biting forceps. Loeb [45] stated that submucous resection was unnecessary and tended to complicate the operation. White [15] preferred to remove primarily a small button of bone adjacent to the base of the septum and then to enlarge the opening laterally and upward with forceps. He also removed the posterior portion of the septum. Cinelli [9] used a split skin graft after Blair's technic. He stressed the importance of securing smooth bone edges and absolute hemostasis in this procedure. The graft, he stated, should be held firmly in place by a rubber tube or catheter for ten days. If the occluding partition is thin, as was mentioned with respect to operation on infants for this condition, electrocoagu-

43. Donnelly, J. C.: New Method of Operation for Congenital Atresia of Posterior Nares, Arch. Otolaryng. **28**:112 (July) 1938.

44. Koch: Case of Congenital Occlusion of Both Nasal Choanae, Laryngoscope **24**:179-182 (March) 1914.

45. Loeb, H.: Operative Surgery of Nose, Throat and Ear, St. Louis, C. V. Mosby Company, 1917, vol. 2, p. 116; cited by Cinelli.[9]

46. Lemere, H. B.: Persistent Bucconasal Membrane in the New-Born, J. A. M. A. **109**:347-348 (July 31) 1937.

47. Pfingst, A. O.: Case of Complete Bilateral Bony Occlusion of Both Nasal Choanae, Laryngoscope [illegible] 179 (March) 1914.

, as well as removal of the posterior third he septum, is to be preferred, according to elli.[9]

Kazanjian [11] reported 3 cases in which he sucsfully used his own technic. The columella ivided close to the floor of the nose. The ision is carried backward and then upward such a way as to free, intact, the whole carginous septum, which is then turned up and of the way. The bony septum, complete with mucous membrane, is removed along with occluding bone. The cartilaginous septum hen turned down and sutured back in place. a result, a large posterior chamber comnicating with the nasopharynx is created. e same end result is achieved by simply reving the posterior third of the septum. The antage of the wide exposure in Kazanjian's [11] ration, however, has its merits.

Morgenstern [34] expressed preference for elecoagulation but stated that it is useful only cases in which the occluding structure is mbranous or is very thin bone. He reported ase, however, in which he used coagulation his office and described this as a relatively ple and painless procedure. During the third tment the coagulating needle, a thin steel trode, pierced a 7 mm. bony obstruction with e. At the end of eight weekly treatments atisfactory result was achieved. The current d was about 300 milliamperes, equivalent to 00 milliamperes when short circuited. It is eworthy that although he coagulated the anior surface of the atretic structure during the rse of the treatments, he also used a curved trode and approached it from the nasoynx. In 1933, when Bourgeois and Leroux [41] roduced electrocoagulation treatment, they d olive tip electrodes. They stressed the fact t this treatment is useful only when the truction is membranous or is very thin bone. The transpalatal approach has been used with cess in a small number of cases in the past. cently Ruddy reported the case of a patient h unilateral atresia on whom he operated in s manner. He devised a technic in which soft palate was reflected posteriorly from bony palate by means of a U-shaped incision, bottom of the U being anterior. This apach allowed a direct view of the obstruction, d it was possible to bite the bony part away rking through both the mouth and the nose. s paper will be published shortly.

Obviously, treatment must vary with differ- cases. If the obstruction is thick and bony, gical treatment is generally believed necesy. The approach may be transseptal; it may be through the nasal passage or through the wide exposure introduced by Kazanjian,[11] or it may be transpalatal. The end result is similar in all cases. The bony obstruction must be removed completely, together with the whole posterior third of the nasal septum. The latter procedure is necessary in order to prevent formation of a cicatrix and hence closure of the opening. Whether or not it is necessary to follow up with electrocoagulation depends on the development of postoperative granulations and scar tissue. If the obstruction is thin, whether membranous or bony, I should prefer to try electrocoagulation first, after the technic of Morgenstern.[34] If this procedure fails, any surgical repair outlined in the foregoing pages may be undertaken without endangering the patient in consequence of the previous treatment.

It is important to remember that in making surgical alterations about the nasal choanae care must be exercised to avoid injuring important nerves and vessels in that region. The posterior palatine canal lies just behind the choanal opening in the outer bony wall, and the pterygopalatine canal is above and just anterior to the choanal orifice. It was pointed out by Stinson [48] that the bony development about these canals is somewhat retarded in cases of choanal atresia. Therefore, they might be easily injured during surgical treatment.

Regardless of the procedure used, care must be exercised to protect the posterior wall of the nasopharynx. This protection may be accomplished by using the finger in the nasopharynx or by using a snugly fitting postnasal pack. If electrocoagulation is used, a bent applicator covered with thick rubber serves the purpose.

Postoperative care has been a subject of great variation. Tin tubes, obturators, catheters, postnasal tampons, gauze strips impregnated with bismuth subcarbonate U. S. P. and simple nasal douching have at times been advocated to prevent scar formation. More recently, skin grafting and electrocoagulation have been added to this list.

If there is postoperative bleeding, packing of some sort is necessary. If the operation has been carefully done without bleeding, there is little necessity for elaborate postoperative care other than the removal of the accumulated secretions either by douching or by gentle nasal suction. If granulation tissue threatens the success of the operation, this tissue should be removed by electrocoagulation.

The choice of anesthesia should suit the individual case. In infants local anesthesia is safest

48. Stinson, W. D.: Osseous Atresia of the Posterior Choanae, Arch. Otolaryng. **15**:101 (Jan.) 1932.

and has proved satisfactory, as the obstruction is usually thin. If the patient is young and a long procedure is anticipated, general anesthesia is preferable. A good anesthetist is essential, and the anesthetic should be administered by the intratracheal method. If electrocoagulation is to be used, chloroform, being noninflammable, is preferable. Ether has been used, though care must be taken to discontinue its use a few minutes before closing the current. Although general anesthesia has usually been used in adults, local anesthesia is satisfactory both for electrocoagulation and for a long surgical procedure.

REPORT OF A CASE

A man of 20 years was admitted to a regional station hospital of the Army Air Forces in July with a fracture-dislocation of the left elbow. He was 5 feet 8½ inches (174 cm.) in height, and weighed 150 pounds (68 Kg.), which he stated was his normal weight. His 3 brothers, mother and father all were living and well. No family history of choanal atresia or other congenital abnormalities could be obtained. He had been inducted into the army six months previously. In taking the history and in physical examination the ward officer found that the patient could not breathe and never had breathed through either nostril. He was referred to the otolaryngologists' department for examination and treatment.

The patient stated that although he had never breathed through his nose, he had become quite resigned to going through life this way because a physician several years ago had told him that nothing could be done to remedy this condition. His early history, his parents stated, was one of marked respiratory and feeding difficulty at birth. He did not gain weight normally,

Fig. 2.—Appearance of the patient with congenital choanal atresia.

and it was not until he was about 1 year of age that he achieved quiet respiration through the mouth. From then on, he gained weight and developed normally. He began to talk shortly after he was 1 year of age. The eruption of his teeth was not retarded. As a child, he caught frequent colds, but they were of short duration. At 2 years of age he contracted pneumonia but recovered promptly. Never did he suffer from earache or running ear. At 12 years of age, tonsillectomy and adenoidectomy were performed to improve his breathing.

The patient stated that his chief difficulty wa annoying secretion which at times would run fr nostrils. He could clear the nasal passage by pressing the soft portion of the nose and so exp secretion into a handkerchief. Usually clearing nose was necessary only once a day. He neve difficulty with swallowing, nor did swallowing his ears. As far as he knew, his hearing was n From childhood he was active and able to parti in all the usual sports. He had never been a

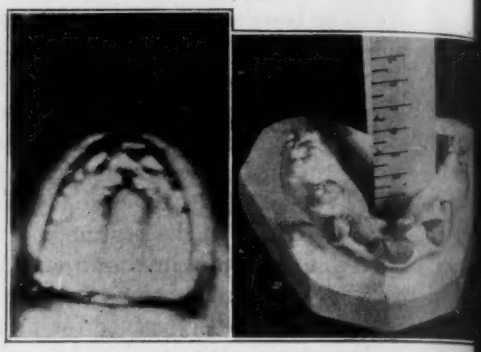


Fig. 3.—The high arch of the palate is demonst The ruler shows centimeters.

smell but could appreciate sweet, sour and salty t He smoked about ten to fifteen cigarets daily believed that he could taste the smoke.

The nose presented no obvious abnormality o formity. The lips were not large and were sli separated (fig. 2). The nasal septum was thick in the midline. There was a small spur lying le the left side posteriorly. Each nostril appeared cious, and the floor of the nose was covered w thick, tenacious mucus. The inferior turbinates at least a half inch above the floor of the no high in fact that they were first mistaken for middle turbinates. Both the inferior and the m turbinates were grossly underdeveloped. On each the inferior turbinate could be traced posteriorl a point where it joined the bony atretic stru The mucous membrane was pale and sodden, al bluish, and in no area were there signs of degener or hypertrophy. Across the back of each nostril a concave partition covered with pale mucous m brane. When this area was palpated with a blunt p it proved to be firm and resistant throughout. partition closed off each posterior choana entirely, irrigation through the nose into the nasopharynx impossible. Nasopharyngeal examination with m showed each choana to be filled with a whitish p tion which seemed smooth, regular and slightly co The posterior portion of the nasal septum was to protrude slightly beyond the obstruction, mor at the base. The vault of the nasopharynx see abnormally low. The eustachian orifices were nor and no adenoid tissue could be made out. The pha geal mucous membrane was pink and shiny, and exudate was noted. The tonsils were absent. hard palate was very high and arched (fig. 3), so n so that the floor of the nose presented a conve from before backward. Palpation of the poste choanal region confirmed the diagnosis. Palpation revealed that the hard palate was so high and vault of the nasopharynx so low that there was l vertical dimension to the choanae. The upper t

irregular. The first incisor, the first bicuspid and rst molar tooth on the left (L 1, L 4, L 6) and cond bicuspid and the first molar tooth on the (R 5, R 6) were absent. His bite was excepy good, and there was little or no protrusion of pper teeth (fig. 4).

earing test done with a Maico audiometer showed ely good hearing (fig. 5).

patient's sense of smell was tested by saturating applicators with test substances and holding within the external nares. The substances used

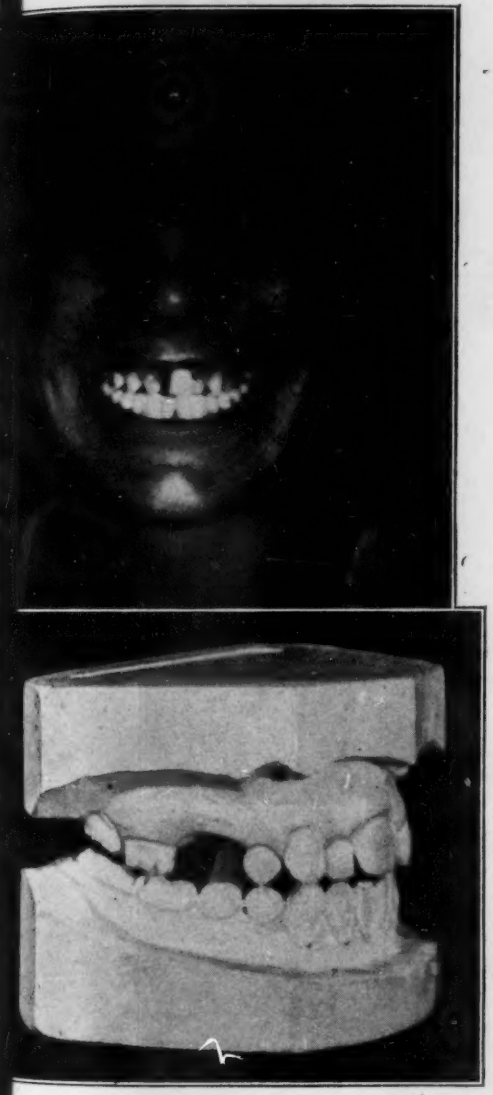


Fig. 4.—The patient's bite is demonstrated.

eucalyptol, oil of orange, oil of anise, oil of mon, oil of peppermint, methyl salicylate, eugenol, atic spirit of ammonia and strong solution of onia. In no case did the patient indicate that uld appreciate any odor.

entgenograms of the sinuses showed them to be ally developed and essentially clear (fig. 6 *A*, *B* *C*). The sphenoid sinuses were small, revealing r thick bone in the roof of the pharynx below. ed poppyseed oil 40 per cent used in lipiodol es of the nasal passages showed complete separation from the nasopharynx. The pharyngeal air shadow closely approximated the shadow of the iodized oil, indicating that in some portion the obstruction was quite thin but nevertheless complete (fig. 6 *D*, *E* and *F*).

The Wassermann test and the results of urinalysis were negative. The clotting time was four minutes and the bleeding time three minutes.

The nasal cavities were cleansed of the collected mucus by means of suction. The interior of the nose was painted with a 5 per cent solution of cocaine hydrochloride to which about 20 minims of a 1:1,000 solution of epinephrine hydrochloride per ounce (0.04 cc per cubic centimeter) had been added. The nasal septum after adequate shrinkage was seen to be so thick that it was felt necessary to do a preliminary submucous resection and then to remove the obstruction through the transseptal route. The mucous membrane of the septum was infiltrated with a 1 per cent solution of procaine hydrochloride to which 6 minims of a 1:1,000 solution of epinephrine hydrochloride per ounce (0.012 cc. per cubic centimeter) had been added, and this infiltration was carried back across the anterior face of the obstruction on either side. Both posterior palatine canals were given 2 cc. of the same solution by injection. The nasopharynx was painted with a 5 per cent solution of cocaine hydrochloride. For further anesthesia, the mucous membrane on the back of the atresial area was infiltrated with a 1 per cent solution of procaine hydrochloride, a curved needle being used and the solution in-

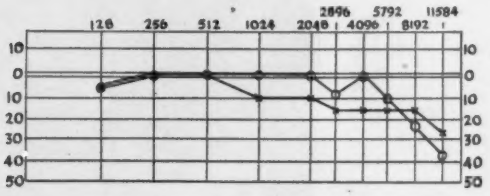


Fig. 5.—The patient's audiogram. The zero level is the level of normal hearing. Circles represent the hearing of the right ear; crosses, that of the left.

jected through the junction of the hard and the soft palate. A postnasal mirror was used to facilitate this procedure.

A postnasal plug was placed firmly in the nasopharynx for the purposes of protection and orientation. The mucous membrane over the atresial area within each nostril was incised, outlining the area to be removed, but the tissue was left in situ. A complete submucous resection was then performed. The bony portion of the septum back to the occluding bone was removed with considerable difficulty because the posterior part of the vomer was very thick. The mucous membrane was elevated laterally, completely separating it from the posterior bony partition on each side. The previously outlined areas of mucoperichondrium were then removed. Following this, the posterior quarter of the septal soft tissue was excised. A chisel and a mallet were employed to go through the occluding bone, which proved to be quite thin in the central area of each choana (approximately 3 mm.). The bone, however, was extremely thick from the rostrum of the sphenoid bone above, down to the hard palate. It was also thick laterally and superiorly (approximately 12 to 14 mm.). The primary central opening could not be enlarged to any great extent with the available biting forceps. Therefore, centrally, superiorly and laterally the bone had to be removed by gently shaving

it away with a chisel. This made the procedure somewhat prolonged and added to the difficulties encountered. The posterior portion of the vomer was completely removed, and the opening was enlarged laterally. Because the hard palate was so high and the roof of the nasopharynx so low, it was impossible to get as much vertical dimension to the opening as had been anticipated. The final opening was about 9 mm. high and 17 mm. for side to side. The bony edges were smoothed with a mastoid curet. Up to this point, there was li no bleeding. When the mucous membrane of the ph was incised, considerable troublesome bleeding occ However, orientation from the postnasal plug m possible to bite away most of the mucous mem piecemeal, without damaging the adjacent pharyn tissue and structure. The postnasal plug was rem from the nasopharynx and two small plugs inserted, one in each choanal area. The layer

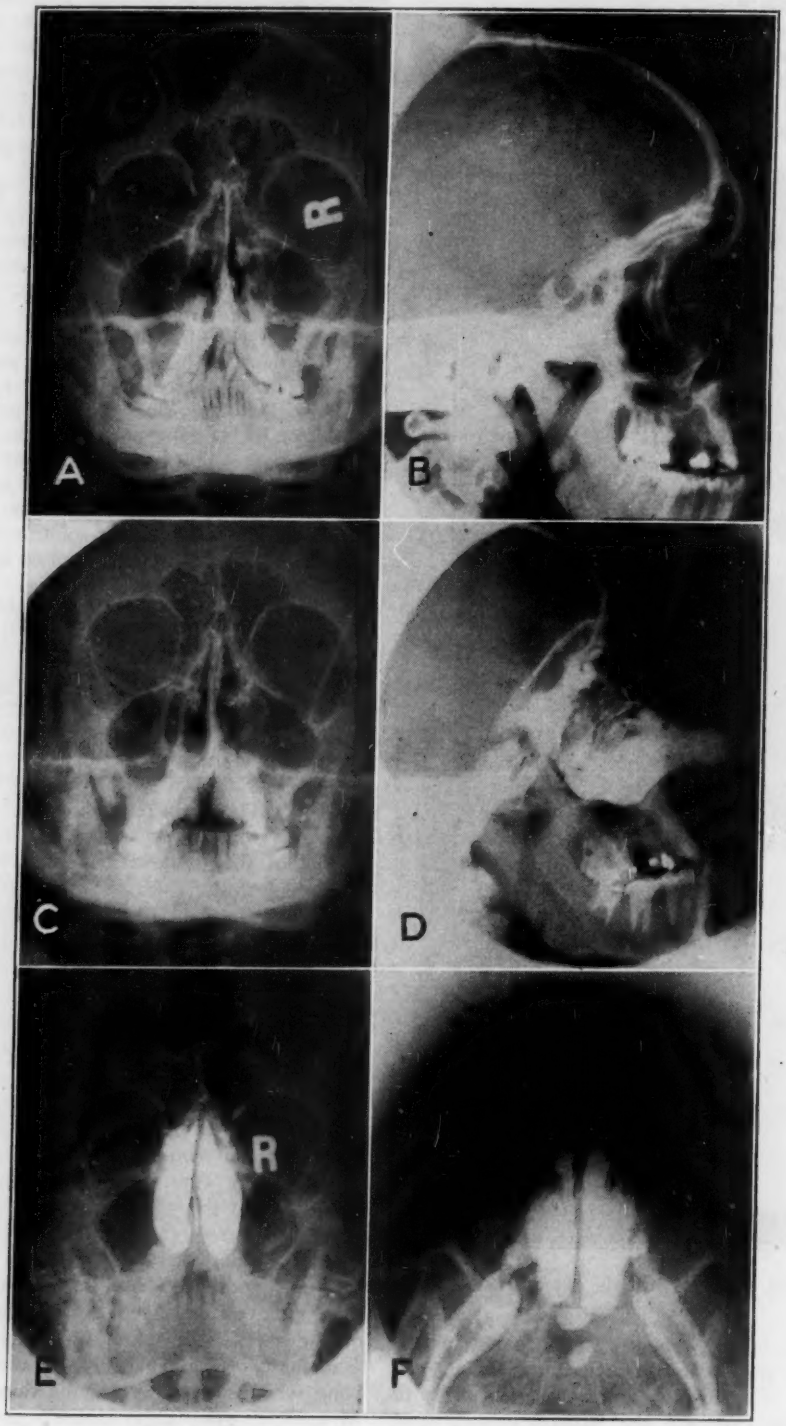


Fig. 6.—*A*, *B* and *C*, roentgenograms showing the sinuses. *D*, *E* and *F*, roentgenograms showing by m of iodized oil the nature of the obstruction at the choanae.

eptum were then approximated and each nostril packed loosely with petrolatum gauze packing. ding was readily controlled.

roughout the entire operation the patient experi- little discomfort, even with use of the chisel and mallet.

e packing and the postnasal plugs were removed days after the operation, at which time consider- bleeding occurred. The hemorrhage was not severe was arrested shortly without packing. The fol- g day a large septal hematoma had formed. This evacuated and the nose loosely repacked. Follow- his packing, the patient complained of slight head- , and a fever developed for the first time, his erature being 100.6 F. The packing was removed -eight hours later, and although there was no ling, considerable edema of the septum had devel- . This edema persisted and made the convales- slow. The nose was cleansed of secretion daily entle suction, a small nasal suction tip being used he instrument, and in ten days a nasal airway, gh very inadequate, was obtained. At the end of a th, the edema had subsided completely, and the nt was able to breathe freely through his nose.

e patient's sense of smell developed slowly. By nd of three weeks oil of peppermint, methyl sali- e and eucalyptol could be distinguished. Aromatic t of ammonia and especially strong solution of onia could be detected at some distance from the . Smoke tasted differently, and food tasted better. appetite had improved.

the end of three months the opening was quite nt and of about the same dimensions as at opera- . The sense of smell had continued to improve. mucous membrane of the nose had become pink appeared more healthy. The turbinates remained phic, but the mucous membrane over them was er and more turgescent. There was no secretion on the floor of the nose, and the patient breathed freely through both nostrils.

It is interesting to note that although this patient never had a nasal passage his general appearance did not bear any resemblance to the "adenoid facies" so often seen in children who have obstruction in the nasopharynx due to adenoids. His upper teeth were irregular but, contrary to general opinion, his bite was normal, and there was no protrusion of the central incisors. The palate was high and arched but symmetric and well developed. There was no asymmetry in the face. The sinuses were normally developed, and there was no evidence of previous sinusitis nor was there sinusitis at the time of operation. There was no history of ear trouble, past or present, and a hearing test showed the patient to have exceptionally good hearing.

SUMMARY

The literature on congenital choanal atresia indicates that many technics have been used in meeting the difficulties encountered in dealing with the condition. The rarity of the anomaly has prevented evaluation of these technics.

Cases of choanal atresia resolve themselves into two main groups, those in which the obstruction is unilateral and those in which it is bilateral.

The cases in which the atresia is unilateral seldom if ever present an emergency.

The cases in which it is bilateral always present an emergency requiring expert care and should be diagnosed at birth. Anatomic repair should be undertaken as soon as the general condition of the child permits.

Occasionally patients with this anomaly reach adult life before corrective measures are taken.

DISTURBED VESTIBULAR FUNCTION

CAUSES AND CURES

MARVIN F. JONES, M.D.
NEW YORK

The symptoms of vestibular irritation are few. They are given in the book of the late Dr. Kerrison as nystagmus, vertigo and ataxia.[1] The causes of these symptoms are many and have been enumerated by me in published articles.[2] Approximately thirty-five known causes for symptoms of vestibular irritation have been reported.

Vestibular irritation can easily be divided into two separate categories: nonsuppurative involvements of the labyrinth and those associated with infection, either local or general. This presentation will consider surgical procedures used to eliminate infections in the temporal bone and thereby relieve labyrinthine symptoms.

Pus located inside the labyrinth usually produces a dead labyrinth. A dead labyrinth will not respond to any stimulation. A labyrinth that is surrounded by pus and is secondarily involved by the inflammatory process usually can be distinguished from a labyrinth containing pus because a response to stimulation is present.

Labyrinthine symptoms observed in a patient who has one dead labyrinth must therefore arise from the remaining end organ and its central connections. Labyrinthitis which is the result of an irritation caused by a surrounding suppurative process is much more difficult to diagnose.

Diffuse suppurative labyrinthitis, therefore, is a disease which is not difficult to recognize, the primary factor being the lack of any response to artificial stimulation. The circumscribed labyrinthitis or the labyrinthitis usually associated with a fistula leading into the wall of the external semicircular canal is also not difficult to diagn In this instance, pressure of any sort exe on the fistula will produce nystagmus and o vestibular symptoms. Another category is c acterized by activity of the labyrinth but an atypical reaction to stimulation. This gory has been designated as diffuse serous l rinthitis.

It is at this point that I wish to confess s of my difficulties. Other diagnoses that ca confused with diffuse serous labyrinthitis hydrops of the labyrinth, acute hyperemia o labyrinth, choked labyrinth and allergic l rinthitis, to mention a few of the many va tions in labyrinthine diagnoses which can s posedly be made. Having found a differentia extremely difficult, I now admit that the var methods I have used to make a diagnosis in past, methods which I have depended on, h proved unsatisfactory. The important goa be attained by making a correct diagnosi cure of the patient.

I have seen patients operated on for s posed purulent labyrinthitis, and the exten labyrinthine operation seemed to me to be questionable value in producing recovery. have hoped that some procedure would be av able whereby a patient could be effectively tre for labyrinthine symptoms without the dan of opening a way into the labyrinth through infected field, since the diagnosis of suppura labyrinthitis may depend on indefinite theo

Dr. F. A. Hemsath and I examined a se of pathologic temporal bones. We found serous, fibrous or serofibrinous exudate in s specimens. One or all of the perilymphatic endolymphatic spaces of the internal ear c tained this exudate. Sometimes we would a serofibrinous exudate in the scala vestibuli a serous exudate in the scala media. Th was destruction of bone and inflammation the bone around the labyrinth in these specim

It occurred to me that patients who suffe from labyrinthine symptoms could be cured a thorough removal of the infected cells s rounding the labyrinth. On many occasion

1. Kerrison, P. D.: Diseases of the Ear, ed. 2, Philadelphia, J. B. Lippincott Company, 1921.

2. Jones, M. F.: Symposium on Manifestations of Diseases Affecting the Cerebral Nerves Supplying Eye, Ear, Nose and Throat Due to Involvement of the Central Nervous System, Tr. Am. Acad. Ophth. **41**:69-81, 1936; Manifestations of Allergy in the Ear, Ann. Otol., Rhin. & Laryng. **47**:910-916, 1938; Trouble Shooting, J. Iowa M. Soc. **30**:509-516, 1940. Jones, M. F., and Converse, J. M.: Carotid Sinus Syndrome, Ann. Otol., Rhin. & Laryng. **50**:805-816, 1941. Jones, M. F.: The Autonomic Nervous System in Health and Disease, Tr. Am. Acad. Ophth. **47**:65-74, 1942.

e tried to do a thorough removal of cells by usual postauricular incision for a radical stoidectomy. In many of these cases, I am l to say, I was successful in relieving the ent of symptoms. My usual procedure was wait until the acute labyrinthitis had subsided then do the usual radical operation on the stoid process. However, there were a few ents who were not relieved of their symp-s. Some of these patients had been operated previously not only by me but by other men. se patients who had recurrences of their yrinthine symptoms are the subject of the sent article.

n doing the endaural mastoidectomy advo-ed by Dr. Julius Lempert, I found that I was a much better position to approach the cells nd the labyrinth, cells which I found diffi-t to reach through the posterior incision. In 25 cases forming the basis of this paper, I either a modified radical or a regular radical stoidectomy, using the Lempert endaural roach. When I say radical mastoidectomy, ean a much more extensive procedure than usually undertaken. I found that by the aural approach I was able to reach cells in petrous part of the temporal bone which e inaccessible through the posterior incision. The patients had labyrinthine symptoms, such vertigo, nausea, vomiting, ataxia and nystag-s. All had a rather characteristic hemicrania deep-seated character. Only my failures are orded in the body of the paper.

Only the essential positive findings have been luded.

REPORT OF CASES

ASE 1.—*Complete Destruction of the Mastoid and rous Portion of the Temporal Bone with Mastoid-tomy; Petrous Exenteration and Labyrinthectomy.*—E., a man aged 48, stated that in 1936, while work-, the right side of his face had become paralyzed. 1938 he reported to the clinic of the Manhattan e, Ear and Throat Hospital. At that time the re-t of the roentgenologist, Dr. F. M. Law, was as ows: "There is absorption of the petrous ridge m the labyrinth to the apex. There is a suggestion a sequestrum over the superior portion of the area the ridge, of absence of cells in the lower half of mastoid process and of the presence of a few cells the superior angle. The lower part of the mastoid cess extending into the inferior marginal pyramid either eroded or has been removed by surgical pro-ure." We felt at that time that a mastoidectomy ght have been done because of the extensive bony avation; there was, however no history of any sur-al procedure.

advised that a mastoidectomy be done. The patient used operation.

He reappeared in the clinic later, Aug. 23, 1943, ause of an acute exacerbation of his chronic mas-toiditis. He complained of a discharging ear, of dizziness and of pain present over that side of the head for the past few weeks. I again advised that he undergo an operation, and again roentgenograms were taken.

There was no particular change in the report of the roentgen examination except for mention of an extension of the original process. The patient had a dead labyrinth on the right side. He was taken to the operating room, and an endaural exploratory operation was started. On making the incision I was sorry that I had started by the endaural route and later, as the operation progressed, I was much pleased that that had been the method of approach.

As an incision was being made in the wall of the external aural canal preparatory to the endural approach, the knife fell into a large cavity. A portion of the membranous wall of the canal was removed and, as usual, the periosteum was elevated over the surgical field. On removing part of the cortex I found complete destruction of the mastoid process. This cavity was filled with a cholesteatomatous mass, the largest I have ever seen at any time. Areas of bone forming the floor, the middle fossa, the lateral wall and the posterior fossa were completely destroyed and dura exposed.

All the remaining bone was removed surgically, leaving a dura-lined cavity. On exploring anteriorly and mesially along the petrous ridge I found complete destruction of the bone, including the petrous portion. A cholesteatomatous mass filled this cavity. Since the labyrinth, which was still fixed in one place by solid bone, prevented complete exploration of the petrous process, the labyrinth was removed in toto. The destruction caused an exposure of the internal carotid artery along its entire course through the petrous process.

In removing the labyrinth, the facial nerve was dissected from its bed, and a defect was found near the lower end of its course through the temporal bone. This accounted for the preexisting facial paralysis. The endolymphatic duct was severed close to the petrous bone, and all structures entering the internal auditory meatus were also severed. Since this procedure necessitated opening the dura, a free flow of cerebrospinal fluid filled the wound. This was a most profuse discharge of cerebrospinal fluid. The flow was controlled by packing.

During the time the patient was on the operating table, his respiration had become poor and a solution of nikethamide was given intravenously.

The patient did rather poorly for the next two or three days, and finally, August 27, he was taken to the operating room, anesthetized with solution of tribromoethanol U. S. P. and ether and a complete dressing of the wound done. The concentration of sulfadiazine in the spinal fluid (the chemotherapy had been started during the operation) was 22 mg. per hundred cubic centimeters. The temperature had risen to 104.6 F. He was given an intravenous injection of a dextrose solution containing a vitamin B concentrate. Following the intravenous medication, he had a chilly sensation, and there was some rigidity of the neck. He had difficulty in swallowing. The wound was dressed again on August 29, when he again had a profuse discharge of cerebrospinal fluid. The dressing was completely saturated. The rigidity of the neck had continued, and the temperature remained high. He seemed to be a little better on this day.

Again a dressing was done on August 30, and the cerebrospinal fluid was less at the time of the dressing

than at that of the previous dressing. The wound was again packed with sulfathiazole paste. On September 2 the temperature was recorded as having been normal during the past two days, with no drainage of cerebrospinal fluid.

On September 29 I examined the larynx and the esophagus because of the continued difficulty in speech and swallowing and found paralysis of the right vocal cord, paralysis of the right side of the soft palate and, of course, the facial paralysis which had been constantly present since the first episode.

a few years but recurred at the age of 20. The [illegible] rence followed an attack of double pneumonia.

One year later pulmonary tuberculosis deve[illegible] The patient was cared for in a sanitarium for pa[illegible] with tuberculosis, and her disease was declared ar[illegible] after seven years. The ear continued to disch[illegible] and pus has persisted until the present time. Th[illegible] years ago she noticed that she became quite dizzy[illegible] that tinnitis had developed. These symptoms have[illegible] sisted until the present time. She has had attac[illegible] falling to the right, but objects do not rotate. [illegible] feels that she herself turns.

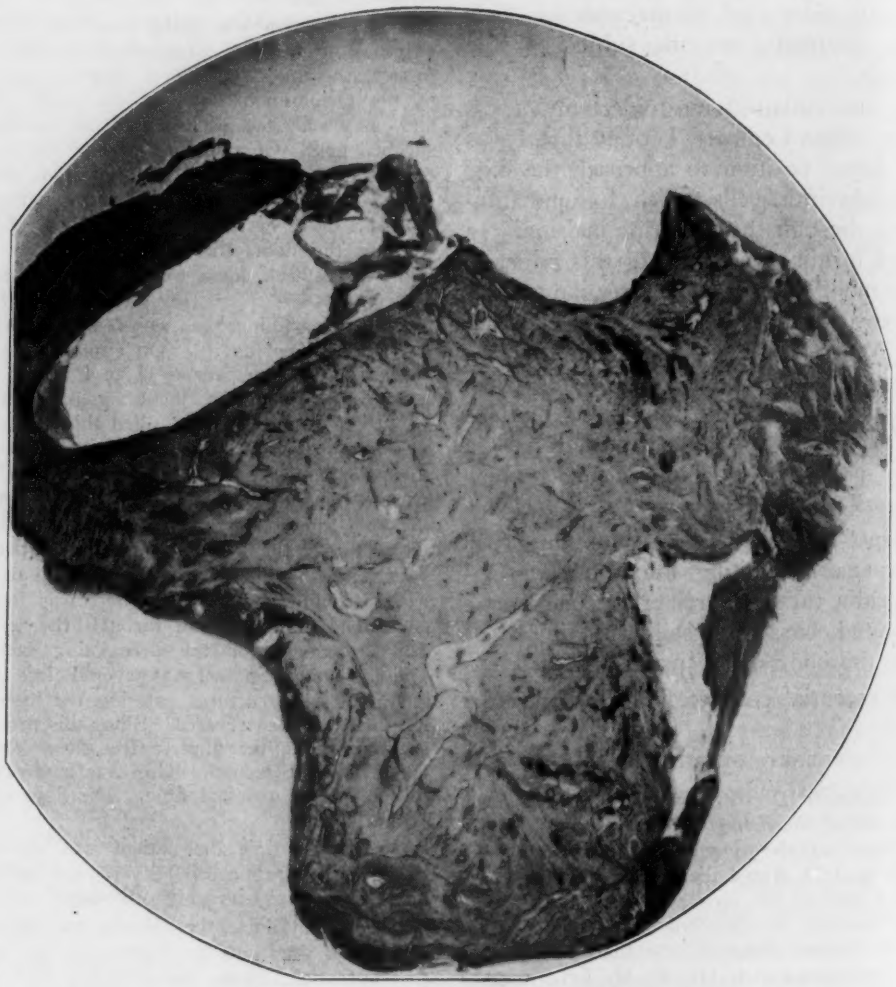


Fig. 1 (case 1).—Fistula in the dead right labyrinth.

This man eventually recovered completely. He now is able to eat regular food. His voice is still hoarse, and there is still paralysis of the right vocal cord, although the right side of the soft palate has had a return of function. The ear is entirely dry for about twenty-four hours at a time and is fairly well epithelized except in one spot.

There is perhaps one more thing to mention. I doubt whether this patient would be alive today had it not been for the aid of the sulfonamide drugs.

Case 2.—A. C., a woman aged 68, stated that her ear trouble began at the age of 6, following an attack of scarlet fever. She had otitis media purulenta acuta on the right side. This apparently cleared up after

She is almost completely deaf in the right ear [illegible] has severe occipital headaches radiating over the en[illegible] head. Laboratory examinations have given unimp[illegible] tant items, the most important being a persistently [illegible] white blood cell count. This ranges around 5,000.

The audiometric examination shows almost total l[illegible] of serviceable hearing in the right ear, but good he[illegible] ing still remains in the left. The bone conduction [illegible] about equal and good on both sides. In the We[illegible] test sound is referred to the left ear; in the Schwab[illegible] test the hearing time is slightly diminished on the ri[illegible] but is normal on the left. The Rinne test shows t[illegible] there is no air conduction on the right; the bone c[illegible]

ion time is ten seconds. On the left, the air con-
ion time is eighteen seconds and the bone conduction
fourteen seconds. A 512 fork was used.
decided to do the radical mastoidectomy, using the
ural approach. The periosteum was reflected, and
mastoid antrum was opened with an electric burr.
re was a pathologic exposure of the dura of the
lle fossa. The posterior semicircular canal was
ned and found to contain a fistulous opening. Like-
, there was pathologic exposure of the facial nerve
ther with necrosis of the labyrinthine wall with
sure of the membranous labyrinth.

was able to retain fluid, and the taking of sulfadiazine with sodium bicarbonate by mouth continued. On October 27 she had some nausea and vomiting, complained of a pain in her abdomen and frequent urination. Since the urinalysis revealed nothing alarming, the taking of sulfadiazine and sodium bicarbonate continued.

She did fairly well although she was extremely weak. On October 31 she was noted to be much stronger and her appetite was improved. The administration of sulfadiazine was then stopped.

Fig. 2 (case 1).—Section through the crista of a semicircular canal of the dead labyrinth.

he entire stapes was necrotic and destroyed except
the footplate. A moderate-sized cholesteatoma was
roughly removed. There was complete destruction
the processus cochleariformis and the tensor tym-
i muscle. The membranous wall was placed in the
toid cavity.

he first postoperative note was made on Oct. 28,
3. There had been postoperative nausea and vom-
g. It occurred during the first and second post-
rative days.

dministration of sulfadiazine was started immedi-
y after the operation, the first dose being given
avenously. The patient was also given sulfadiazine
mouth but vomited each dose. On October 26 she

The patient's improvement continued, and nausea and dizziness ceased; the headache disappeared, and the wound was healing nicely. She was discharged from the hospital on December 4, symptomless, to return to the clinic. She continued in good condition until her recent readmission to the hospital. She had a recurrence of her symptoms, and although I have not been able to prove it, I believe that the osseous lesion is tuberculous.

CASE 3.—J. S., a man aged 49, when he consulted me had typical symptoms of petrositis and labyrinthine involvement. He had diplopia, retro-orbital pain, hemicrania, nausea, vomiting, nystagmus and ataxia. He had had previous operations on the ear. There was a profuse discharge from the external canal and swell-

ing around the auricle. I explored the petrous process through the gasserian ganglion approach. He entirely recovered and accepted an assignment in the Pacific war theater.

He was subjected to prolonged exposure in salt water, and, following this, his symptoms recurred. He was again operated on by me, Oct. 28, 1941, at which time I did the endaural removal of the perilabyrinthine cells. He recovered, and the external canal was epithelized and dry. Only recently he had a recurrence of his hemicrania, extreme sensitiveness in the middle ear, dizziness and apprehension.

the labyrinth which does not respond. degree of a positive response to stimulation labyrinth has been found to be most unreli as an indicator of the degree of labyrinth involvement. I have also found that lesions the posterior fossa and particularly bulbar les may be easily confused with labyrinthine invo ment.

On occasion I have made a positive diagn of labyrinthitis and, with great chagrin, h

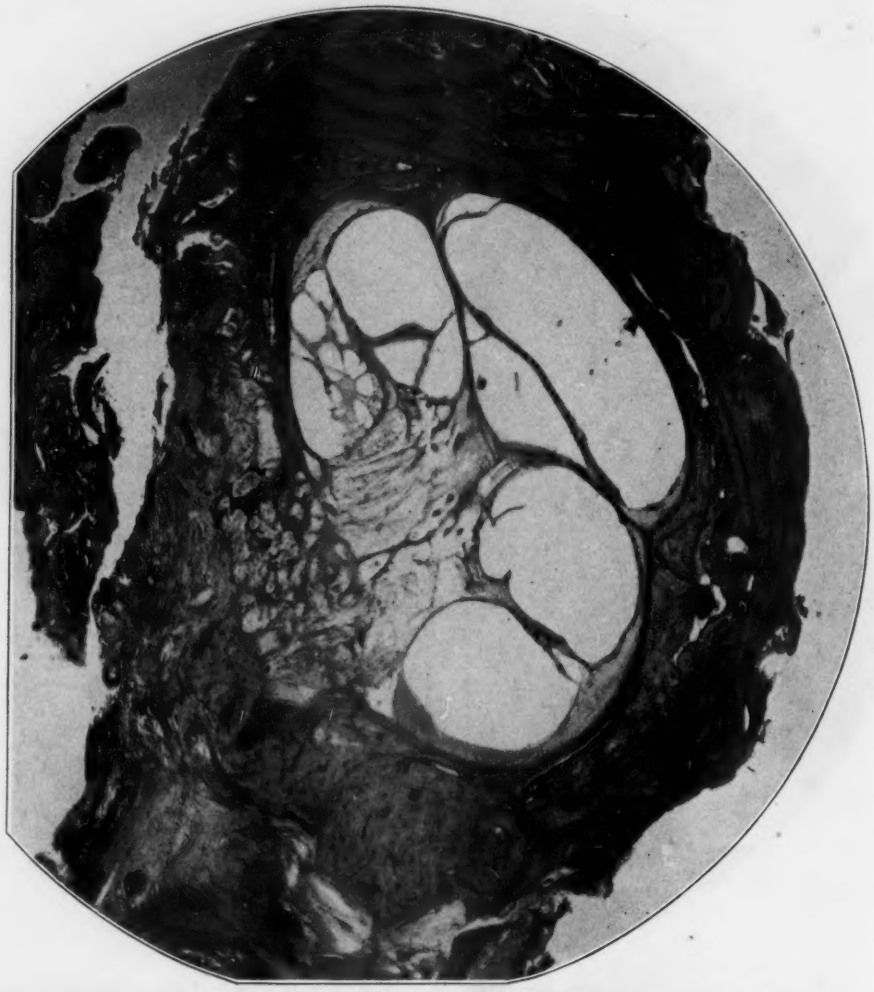


Fig. 3 (case 1).—Section through the cochlea of the removed labyrinth.

Although there are no findings on which to base the diagnosis of an intracranial lesion, I believe he has pus somewhere in his cranial cavity. He has been advised by me to have another exploratory operation when I return to New York.

Two generalities which are contrary to the usual opinion are here presented. I have found the rotation test to be of little value as far as positive information on perilabyrinthitis is concerned. The caloric test is of value to the extent that it will eliminate from the present discussion

found either by operation or by autopsy t I had been entirely wrong. My arbitrary a tude in making a diagnosis has been grea reduced by the humiliation of having to ackno edge that I was mistaken. Another fact tha find hard to understand is that there can b functioning cochlear labyrinth and a nonfu tioning vestibular labyrinth. The reverse a holds true.

These statements carry a moral. It seems perative that otologists should thoroughly revi

their supposed facts dealing with normal func-
n and disturbances of function as these apply
the vestibular and cochlear apparatus. It
uld seem necessary that they also review crit-
lly the tests which they have been accustomed
use and on which they depend to make a
gnosis. The main lesson which I believe I
ve learned is that patients with symptoms indi-
ing inflammatory labyrinthine involvement
er than diffuse suppurative labyrinthitis should
have an operation on the labyrinth itself until a method of removing perilabyrinthine cells has been tried. Most of the patients in this group had had previous operations by competent aural surgeons. Some of these operations were effective for a short period, but the recurrence of symptoms showed that a diseased process was present beyond the operative field. It is in the last-named instances that the results of an operation which I have described have been most satisfactory.

121 East Sixtieth Street.

EFFECT OF SULFATHIAZOLE IN CHEWING GUM IN CERTAIN OROPHARYNGEAL INFECTIONS

A PRELIMINARY REPORT

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CHICAGO

The bacteriostatic effectiveness of the sulfonamide drugs is well established. Although the mechanism by which these drugs produce their inhibitory influence is not completely understood, numerous clinical and laboratory studies have demonstrated that the drugs are useful in preventing and controlling certain types of infection if they are maintained at the wound site in sufficient concentration.

Early studies were concerned with building up and maintaining blood levels of the drugs by oral administration, but more recent work has shown that the direct local application of the drugs in accessible areas is highly efficient.

Effective topical application of the drugs to diseased or injured oropharyngeal tissues has been difficult, mainly because mechanical factors prevented the maintenance of a satisfactory concentration of the drug. The smooth oral mucosa is continually washed by saliva and does not lend itself favorably to treatment by powders, ointments or solutions. Beneficial results from the local application of sulfonamide drugs in the mouth have been reported, but they occurred in such areas as the alveolus of an extracted tooth or a cavity in the maxilla or mandible where the drug was sheltered from swallowing and salivary dilution.

A vehicle was therefore sought which would keep sulfonamide drugs in the mouth in sufficient concentration over a long enough period of time to benefit the oropharyngeal tissues by the bacteriostatic action of the drug. It was recognized that for the results desired the drug should be released slowly from the vehicle, thus providing a high and sustained concentration of the drug to avoid systemic complications.

The choice of chewing gum as the vehi seemed indicated, because it offered possibili that the drug would not be rapidly extrac from the gum and swallowed. In the beginni of these experiments the material used w obtained by melting the ordinary type of che ing gum and incorporating a fixed amount of sulfathiazole in it. However, with the advent the war and the difficulty in securing gum, found it necessary to seek aid from the Wh Laboratories, who were already producing acetylsalicylic acid–impregnated chewing gum

The question as to the most efficient sulf amide drug was resolved by studies of the saliv levels of sulfonamide compound attained apparently normal adult subjects while chew gum tablets containing sulfanilamide, sul thiazole or sulfadiazine for one hour. Each su ject was carefully instructed to chew the me cated gum as he would ordinary chewing g but to swallow no saliva during the hour's che ing. All saliva excreted during the experim by each subject was collected as consecut samples for the time period noted in chart Spectrophotometric determinations of the cont of sulfonamide compound in filtered porti were made promptly after collection of e sample, according to the method of Bratton a Marshall. The three distinct patterns salivary levels of sulfonamide compound tained by an hour's chewing of gum tablets c taining sulfanilamide, sulfathiazole and sul diazine are illustrated in chart 1.

Volume and hydrogen ion concentration secreted saliva and rate and forcefulness mastication influence the amount of sulfonami compound extracted from the chewing gum each subject. Beyond this, however, it can generalized that (1) the constancy with wh a sulfonamide compound is extracted from che ing gum and (2) the salivary concentrati which is attained by a sulfonamide compou during the chewing of the gum are in inver ratio to the water solubility of the drug. 37 C., the limited solubility of sulfadiazi

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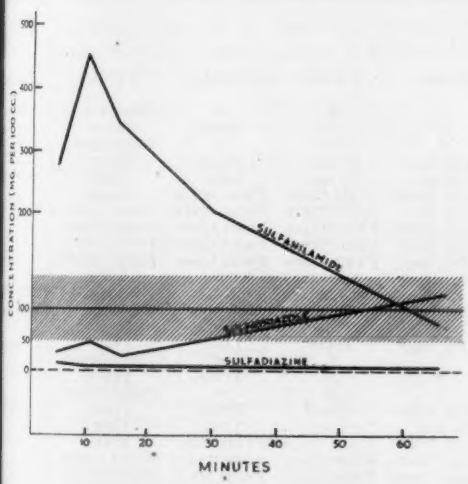
The research reported in this paper was subsidized in part by a grant from the White Laboratories, Inc., Newark, New Jersey.

:8300) allows a prolonged and constant re-se of this drug from the gum; but it restricts ivary concentrations of the dissolved drug to els much below those attained with either fanilamide or sulfathiazole. The considerably ater solubility of sulfanilamide (1:67 at C.) results in an inconstant, quicker rate of lease from the chewing gum.

The solubility of sulfathiazole (1:1060 at C.), intermediate between that of sulfanil-ide and of sulfadiazine, not only allows a nstant and sustained extraction of the drug m the chewing gum but also provides a defi-ely bacteriostatic concentration of sulfathiazole saliva throughout a full hour of chewing.

We have estimated a range of highly anti-terial but systemically nontoxic salivary els of sulfonamide compound, within the upper



hart 1.—Average salivary concentrations of dissolved fonamide compound during experimental use of chew-gum tablets each of which contained approximately 7 Gm. of sulfanilamide, sulfathiazole or sulfadiazine.

it of which the amount of the drug likely to ingested and to enter general circulation re-ins minimal. This range of salivary levels sulfonamide compound is indicated in chart 1 from 50 to 150 mg. per hundred cubic centi-ters. From the standpoint of relative anti-terial potency, a salivary concentration of fathiazole within this range was found to be re effective in vitro against common bacterial hogens of mouth and throat (notably hemo-ic streptococci) than the maximal salivary centration of sulfadiazine. From the stand-nt of minimal systemic toxicity, sustained ivary levels of sulfonamide compound cannot ceed the upper limit of this range (150 mg. per ndred cubic centimeters) if blood concentra-ns are to be restricted to from 1 to 2 mg. hundred cubic centimeters or less.

From these experimental data it seems that chewing gum containing sulfathiazole rather than sulfanilamide or sulfadiazine is preferable for local chemotherapy of oral and pharyngeal infections susceptible to sulfonamide drugs.

In order to determine the content of sulfathiazole in a chewing gum tablet which, during chewing of the tablet, would lend itself to extraction from the gum at an average rate closely approximating the salivary solubility of the drug, chewing gum tablets containing amounts of sulfathiazole varying roughly from 0.15 to 0.4 Gm. per tablet were studied experimentally. The average salivary levels of total and dissolved sulfathiazole in apparently normal adults were determined and compared.

The amount of sulfathiazole which was concluded to be the optimal content per chewing gum tablet was 0.25 Gm. In chart 2 are graphed the average salivary concentration of both total and dissolved sulfathiazole in a series of subjects, each of whom chewed a gum tablet containing 0.25 Gm. of sulfathiazole for one hour.

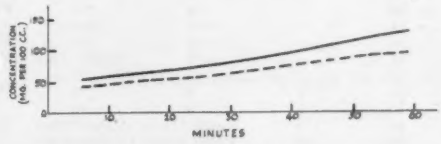


Chart 2.—Average salivary concentrations of sulfathiazole during chewing of gum tablets each of which contained approximately 0.25 Gm. of sulfathiazole. The solid line represents total sulfathiazole concentration, and the broken line represents dissolved sulfathiazole concentration.

It is most interesting to note that even at the end of one hour's chewing the residua of sulfathiazole in chewing gum cuds varied from 43 to 88 per cent of the tablets' original content. This variation is caused largely by individual differences in the volume of secreted saliva and the low solubility rate in saliva. Increased secretion of saliva during one hour's chewing of sulfathiazole gum results in the extraction of a larger percentage of the drug from the gum and so serves to maintain the salivary concentrations of total and dissolved sulfathiazole at relatively constant levels. Thus sulfathiazole gum provides a method of chemotherapy for oropharyngeal use and is topical in a strict sense of the term, as shown by the extremely low blood levels of sulfathiazole resulting from intensive dosage with the preparation.

Blood Levels.—In order to determine the amount of sulfathiazole that would be absorbed in the process of chewing sulfathiazole gum and swallowing the resultant saliva-drug mixture, a

group of 22 persons chewed gum tablets for one-half hour every hour from 8 a. m. to 8 p. m. Adults chewed two tablets at a time and children one. Blood determinations of sulfathiazole were made by the micromethod every hour for four hours and then every other hour for the remainder of the twelve hours. A final determination was made at 9 a. m. the following morning. The individual results are shown in table 1.

The majority of the subjects showed a faint trace of sulfathiazole in the blood at the end of four hours. At the end of twelve hours all had evidence of the drug in the blood stream, but in only 5 was it present in measurable quantities. Four had a level of 0.5 mg. per hundred cubic centimeters while 1 had 1 mg. Only 2 subjects showed a trace of the drug at the twenty-four hour interval. Thus it may be concluded that chewing the gum in greater quantities than ordinarily prescribed does not produce a blood content of sulfathiazole approaching the level generally maintained in systemic therapy, which averages 10 mg. per hundred cubic centimeters. However, it is recognized that a small number of persons are allergic to sulfonamide drugs. While only a minimum amount of the drug is absorbed from the gum, the patient must be questioned about possible sensitivity; and if any indication of sulfonamide allergy is elicited, the gum should not be prescribed. Patients must also be impressed with the necessity for complying with the prescribed treatment, so that they will not chew the medicated gum excessively.

TABLE 1.—*Determinations of Sulfathiazole by Milligrams per Hundred Cubic Centimeters of Blood* **

Subjects										
Weight, Lbs.	Age, Yr.	9 A.M.	10 A.M.	11 A.M.	12 Noon	2 P.M.	4 P.M.	6 P.M.	8 P.M.	9 A.M
180	14	0	0	0	0	0	0	0	Faint trace	0
65	8	0	0	0	0	0	0	Trace	Trace	0
185	16	0	0	0	0	0	0	0	Faint trace	0
110	16	0	0	0	Faint trace	Faint trace	Trace	Trace	Trace	0
105	14	0	0	Trace	Trace	0.5 mg.	0.6 mg.	1 mg.	1 mg.	0
83	10	0	0	0	Faint trace	Faint trace	Faint trace	Faint trace	Trace	0
135	17	0	0	Faint trace	Faint trace	Faint trace	Faint trace	Faint trace	Faint trace	0
104	13	0	0	0	0	Faint tract	Faint trace	Faint trace	Faint trace	0
113	13	0	0	0	Faint trace	Faint trace	Faint trace	Faint trace	Faint trace	0
165	15	0	0	0	0	Faint tract	Faint trace	Faint trace	Faint trace	0
130	45	0	Faint trace	Faint trace	Faint trace	Faint trace	0.5 mg.	0.5 mg.	0.5 mg.	0
130	55	0	Faint trace	Faint trace	Trace	Trace	0.5 mg.	0.5 mg.	0.5 mg.	Faint t
127	70	0	0	0	Faint trace	Faint trace	Trace	0.5 mg.	0.5 mg.	Faint t
115	74	0	Faint trace	Faint trace	Faint trace	Faint trace	Trace	Trace	Trace	0
152	42	0	0	Faint trace	Faint trace	Faint trace	Trace	Trace	Trace	0
180	14	0	0	0	0	0	0	0	Faint trace	0
65	8	0	0	0	0	0	0	Trace	Trace	0
165	16	0	0	0	0	0	0	0	Faint trace	0
110	16	0	0	0	Faint trace	Faint trace	Trace	Trace	Trace	0
105	14	0	0	Trace	Trace	0.5 mg.	0.6 mg.	1 mg.	1 mg.	0
83	10	0	0	0	Faint trace	Faint trace	Faint trace	Faint trace	Trace	0
135	17	0	0	Faint trace	Faint trace	Faint trace	Faint trace	Faint trace	Faint trace	0
104	13	0	0	0	0	Faint trace	Faint trace	Faine trace	Faint trace	0
113	13	0	0	0	Faint trace	Faint trace	Faint trace	Faint trace	Faint trace	0
165	15	0	0	0	0	Faint trace	Faint trace	Faine trace	Faint trace	0

* "Faint trace" and "trace" were used where the color change was too pale to compare witth the lowest standard.

Bacteriologic Procedure.—A study of effect of a medicinal agent on the oral bacte flora has many complications. The tremend number and variety of micro-organisms, influence of eating, the natural increase in flora during the day and the difficulty of secur uniform inoculums for comparative analyses some of the problems. Kligler,[1] in a quantita study of the oral flora, found that 1 mg. of m rial scraped from the surface of a tooth near gum contained anywhere from 10,000,000 540,000,000 bacterial bodies; 1 cc. of sa averaged 25,000,000 micro-organisms, the jority of which were cocci. Kligler estima that 75 per cent of the bacterial flora of normal mouth were cocci, 40 per cent of th being streptococci. Appleton[2] has shown there is an increase in the number of bacteri the mouth during the day, a so-called diu tide, except for short periods immediately a eating, when there is a decrease. This ob vation indicates that material for compara quantitative studies of the oral bacteria sh be obtained at the same time of day. Bib in extensive and carefully performed comp sons of the types and numbers of bacteri various parts of the mouth and from studie different persons, concluded that the result quantitative studies by methods now avail

1. Kligler, I. J.: J. Allied Dent. Soc. **10**:141, and 445, 1915.

2. Appleton, J. L. T.: Bacterial Infection, e Philadelphia, Lea & Febiger, 1933.

3. Bibby, B. G.: J. Dent. Research **17**:265, and 471, 1938.

so inconsistent that they do not permit nificant statistical analyses.

Despite the recognized difficulties, an attempt s made to study the effect of the sulfathiazole n on the oral flora of persons suffering m various oropharyngeal disorders. The pa- t was asked to rinse the mouth vigorously one minute with 10 cc. of sterile 0.85 per t solution of sodium chloride, and the rinsing s then collected in a sterile bottle and shaken rously for one minute. One cubic centi- ter of the rinsing was transferred to 9 cc. of terile 0.85 per cent solution of sodium chlo- e, and from this suspension various dilutions e made. Previous tests had shown that 0.2 cc. dilutions 1 : 10,000 and 1 : 100,000 spread on surface of agar mediums usually produced nial growth which could be counted satis- torily. Blood agar medium was used, con- ing 5 mg. of paraaminobenzoic acid per liter order to eliminate any bacteriostatic effect of sulfonamide drug carried over in the rinsing. tes were made in duplicate for aerobic and erobic cultivation. Brewer's plates were used anaerobiosis.

Control rinsings were obtained and cultured m the various persons studied before the tment with gum was instituted, or, if the ient required immediate medication on his t visit, control rinsings were obtained after oral condition had returned to normal and chewing of the gum had been discontinued.

The procedure of treatment usually consisted having the patient chew a tablet of the gum taining 0.25 Gm. of sulfathiazole for one r every three hours, except when a severe ction of the throat was present, in which case patient was instructed to chew for one hour rest one hour.

Patients were divided into five groups accord- to their clinical conditions. These were ulceromembranous stomatitis, acute follicular tonsillitis, acute lymphoid pharyngitis, acute and chronic salivary adenitis and hyperplastic pansinusitis and stomatitis. The results of the comparative cultures made from mouth rinsings of these patients when using and when not using gum are shown in table 2. Comparisons were made between the total numbers of bacteria per cubic centimeter of mouth rinsings and also between certain types of bacteria commonly found. The increase or decrease in the numbers of the various types of organisms was based on their ratio to the total count for the particular rinsing. The table shows the percentage of increase or decrease in the total counts for the different types of bacteria.

Our experience was similar to that of others who have made comparative studies of the oral flora. The results were so variable by this method of obtaining the inoculums that no conclusions can be drawn in regard to changes in the bacterial flora. There was a tendency in the majority of the patients for the total number of bacteria to diminish, but in some the total counts increased despite the chewing of gum. Usually the rise was due, however, to an increase in the supposedly less virulent types of organisms, such as the diplococcic and bacillary types. Attempts are under way to perfect a method for securing more uniform inoculums so that a more accurate check may be obtained on the variations in the oral flora.

Particularly interesting are the pictures presented by those conditions in which beta streptococci are so frequently the preponderant, offending organisms. These include acute follicular tonsillitis, acute lymphoid pharyngitis and the Plaut-Vincent type of ulcerative gingivitis and stomatitis. It will be noted that in 52 cases of acute lymphoid pharyngitis and follicular tonsillitis, 72 per cent showed a decided decrease in

TABLE 2.—*Percentages of Decrease and Increase in Numbers of Organisms Found in Mouth Rinsings from Patients with Oropharyngeal Infections When Medicated Gum Was Chewed and Not Chewed*

	Ulcerative Stomatitis and Gingivitis		Acute Follicular Tonsillitis		Acute Lymphoid Pharyngitis		Acute and Chronic Salivary Adenitis		Hyperplastic Pansinusitis and Stomatitis	
ber of cases	38		24		28		5		19	
	Percentage of Increase	Percentage of Decrease	Percentage of Increase	Percentage of Decrease	Percentage of Increase	Percentage of Decrease	Percentage of Increase	Percentage of Decrease	Percentage of Increase	Percentage of Decrease
al counts	33	67	28	72	28	72	33	67	44	56
e of bacteria found										
Alpha streptococcus	50	50	44	56	48	52	50	50	42	58
Beta streptococcus	25	75	..	100	..	100	..	100	..	..
Gamma streptococcus	50	50	26	64	47	53	28	72	50	50
Staphylococcus aureus (hemolytic)	50	50	..	..	67	33	..	..	100	..
Staphylococcus aureus (nonhemolytic)	56	44	67	33	..	..	60	40	..	100
Micrococcus catarrhalis	57	43	80	20	52	48	75	25	..	..
Gram-positive bacilli	40	60	..	..	..	100	..	..	28	72
Gram-negative bacilli	50	50	43	57	57	43	100	..	50	50
Gram-positive diplococcus	56	44	75	25	60	40	50	50	72	28

total count within forty-eight hours, along with the complete disappearance of the beta streptococci in the cultures. In 38 cases of ulcerative stomatitis, a decrease in total count was noted in 67 per cent, with a 75 per cent decrease in the beta streptococci within forty-eight hours. Even more spectacular was the rapid clinical resolution of these conditions. Before the advent of sulfonamide therapy, it was the rule for an acute follicular tonsillitis to drag along for seven to ten days in spite of all known medication. The use locally of sulfonamide drugs in a gum base has shortened this period of illness considerably.

The same situation holds true in the Plaut-Vincent ulcerative type of stomatitis. It has been demonstrated that to produce this disease, a streptococcus must be introduced into the culture of Plaut-Vincent organisms.[4] Neither alone is capable of producing the condition. The specificity of sulfathiazole for the streptococcus probably accounts for the very rapid alleviation of this condition by the chewing of sulfathiazole gum.

In the chronic mouth conditions, such as chronic salivary adenitis and catarrhal stomatitis associated with mouth breathing in persons with hyperplastic pansinusitis, a decrease in the total count is also noted. The response, however, is not as pronounced as in the previously mentioned conditions. Here the preponderant organisms are the alpha and gamma types of streptococcus, which apparently are not as greatly affected by the sulfathiazole as the hemolytic streptococci. Improvement is noted clinically in these conditions by disappearance of the mouth odor and the coated tongue which were previously present.

Effect of Chewing Nonmedicated Gum.—It is a recognized fact that the act of chewing in itself is a mouth cleansing process. Kligler [1] found that eating reduced the flora by 50 per cent, and tobacco chewing by 75 per cent. Appleton [2] found a reduction of 20 to 30 per cent in the number of bacteria obtainable by rinsing the mouth before and after eating. In another experiment Appleton and associates [5] showed a decided increase in the disappearance of Serratia marcescens seeded into the mouth of a person whose salivary flow was stimulated by the chewing of paraffin.

In order to determine the effect of chewing gum on the oral environment, tablets of gum with the sulfathiazole omitted were supplied to 10 sons. Mouth rinsings were secured immedi before lunch from all persons for eight cons tive days. The rinsings were treated and tured in the usual manner. The average o eight counts was used as the normal leve the flora for the person. Then he was instru to chew a tablet of the gum for one hour fol ing each meal, that is, three times daily, for days. A mouth rinsing was obtained each immediately before lunch. The average o eight counts for each person was obtained used as the level of the flora at noon under gum chewing regimen. Following one we rest, each person was supplied with sulfathia gum and instructed to use it in the same ma as the nonmedicated gum. The chewing continued for eight days, and the average c for the noon rinsings was obtained. The re are given in chart 3.

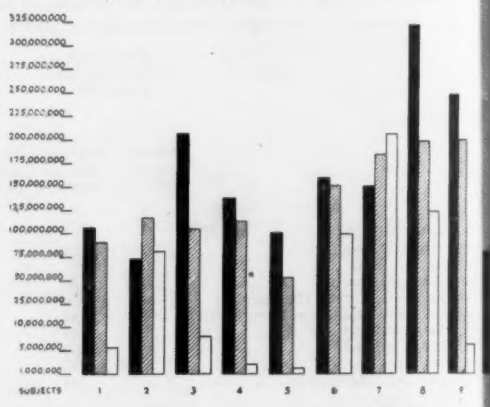


Chart 3.—Average count of oral bacterial flora cubic centimeter of mouth rinsings. The black col represents the average count before chewing nonm cated gum; the shaded one represents the average c after chewing nonmedicated gum, and the white represents the average count after chewing gum taining sulfathiazole.

When the 10 normal persons chewed n medicated gum as described, 7 showed a duction in the bacterial counts made from t mouth rinsings; in 3 there was some increa This was invariably due to extremely h counts obtained following the first day of ch ing gum. In fact, all 10 gave their high counts on the first day. This result may h been due to the disturbance created in the environment by chewing of gum and to consequent dislodgment of the bacteria fr the oral surfaces. The subsequent reduction the number of bacteria obtained from the mo rinsings during the gum chewing regimen the inability of the oral flora to regain its origi

4. Smith, D.: Oral Spirochetes and Related Organisms, Baltimore, Williams & Wilkins Company, 1932.

5. Appleton, J. L. T.; Klein, H., and Palmer, C. E.: Am. J. Hyg. **28**:213, 1938.

were probably due to the mechanical effect the chewing of gum and the flushing and ing action of the saliva.

Eight of the 10 subjects showed a striking rease in the bacterial counts of the mouth sings obtained during the chewing of medi- ed gum. In 6 there was a drop of from 70 250 million per cubic centimeter. This great duction was apparently the result of the chemo- rapeutic properties of the sulfathiazole. In persons, for unaccountable reasons, the aver- e count from the rinsings was higher following the chewing of medicated gum.

CONCLUSIONS

1. Chewing of gum appears to be a mouth-cleansing process.

2. From the standpoint of minimal systemic toxicity and maximal local antibacterial potency, sulfathiazole in chewing gum seems to be the preferable local chemotherapy for infections of oral and pharyngeal mucosa which are susceptible to sulfonamide compounds.

3. Best clinical results are obtained in those conditions of the mouth and pharynx in which the beta hemolytic streptococcus is the preponderant etiologic organism.

TUMORS OF THE TRACHEA

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Although the incidence of bronchiogenic carcinoma has increased tremendously in the past decade, a similar increase has not been noted in the incidence of the several types of tumor of the trachea. Tumor of the trachea occurs infrequently, and its rarity has been stressed in all comprehensive reviews of the subject. Culp,[1] in a review of the literature up to 1938, found but 147 cases of carcinoma of the trachea and in only 82 of these cases were there accurate histologic data. Unfortunately, the diagnosis of carcinoma of the trachea is generally established late in the course of the disease, and as a result successful treatment is usually impossible. Therefore, a study of the symptoms, the physical signs and the diagnostic procedures that may facilitate the earlier diagnosis of tumor of the trachea seems of value.

The present study is based on a review of 27 cases of neoplasm of the trachea seen at the Mayo Clinic since 1921. Data on 13 of these cases have been reported previously by Olsen,[2] Figi[3] and Vinson and Leddy.[4] Olsen and Figi reported data on 3 additional cases, which, however, are not included in our study. Fourteen cases, therefore, have not been previously reported. In all instances the diagnosis was established during life by biopsy of specimens obtained endoscopically or at the time of surgical exploration.

SITUATION OF THE TUMORS

Carcinoma may occur anywhere in the trachea, as illustrated in the accompanying table. In our experience the lower third of the trachea is the region most likely to be involved; in 15 of the cases (56 per cent) the lesion occurred in this region. The tumor arose in the upper third in 8 cases and in the middle third in 1 case. In remaining 3 instances so great a portion of trachea was involved that the exact site of or of the primary lesion could not be accurately termined. In general the tracheal tumors w most frequently situated on the posterior lateral walls in the lower third of the trac The middle third and the anterior wall were l often involved. It is interesting that there a tendency on the part of cylindroma to inv the upper third of the trachea, whereas squam cell carcinoma and adenocarcinoma usually w found in the lower third.

CLINICAL FEATURES

The importance of mechanical factors in production of the symptoms of tumor of trachea has been emphasized by Jackson.[5] T tumor may act as a bivalve and allow air to p in and out of the lung in decreased quantity. may act as a stop valve and prevent air fr passing in either direction. When the les functions as a check valve there may be ingr but no egress of air, in which case emphysema produced. If the check valve prevents ingr but allows air to escape, atelectasis results.

Culp,[1] Simpson and Moore[6] and Miller[7] ha stressed the importance of a tickling sensation the throat as a frequent initial symptom of t cheal tumor. Only 3 patients in our group h any sensation of tickling or of lump in the thr In our experience the most frequent and portant symptom was dyspnea caused by croachment of the tumor on, and obstruction the tracheal lumen. Dyspnea was a promin symptom in 24 cases (89 per cent) and was initial symptom in 22 (81 per cent). Dysp may be constant or paroxysmal and is fairly quently affected by change of position. Th patients noticed a marked increase of respirat

From the Division of Medicine (Drs. Tinney and Moersch) and the Division of Surgical Pathology (Dr. McDonald), Mayo Clinic.

1. Culp, O. S.: Primary Carcinoma of the Trachea, J. Thoracic Surg. **7**:471-487 (June) 1938.

2. Olsen, A. M.: Carcinoma of the Trachea, Arch. Otolaryng. **30**:615-630 (Oct.) 1939.

3. Figi, F. A.: Primary Carcinoma of the Trachea, Arch. Otolaryng. **12**:446-456 (Oct.) 1930.

4. Vinson, P. P., and Leddy, E. T.: Carcinoma of the Trachea, Proc. Staff Meet., Mayo Clin. **8**:641-643 (Oct. 25) 1933.

5. Jackson, C.: Tumors of the Trachea, So Surgeon **5**:263-276 (Aug.) 1936.

6. Simpson, W. L., and Moore, R. M.: Prim Colloid Adenocarcinoma of the Lower Third of Trachea, Ann. Otol., Rhin. & Laryng. **43**:1133- (Dec.) 1934.

7. Miller, I.: Primary Carcinoma of the Trac Arch. Otolaryng. **31**:675-679 (April) 1940.

ress when they lay on the back or on either . Acute nocturnal paroxysmal dyspnea is lly caused by an accumulation of secretion in tracheobronchial tree or by the prolapse of a nculated tumor. These respiratory crises particularly likely to occur when there is sec- ary infection in the trachea or the bronchi.

ackson [5] has stated that the most important ptom of the presence of a tracheal growth is heeze heard at the open mouth and has de- ed this as an asthmatoid wheeze. The nd is caused by a column of air set in vibra- by passing through a narrowed lumen. He

Chills and fever, frequent accompaniments of bronchiogenic carcinoma, are less likely to occur in cases of tracheal tumor. When fever is present it may be caused by necrosis and suppuration of the tumor, but it is usually produced by pulmonary infection distal to the site of the tracheal obstruction. Four patients in our series had chills and fever as a prominent part of their clinical course. Occasionally an acute febrile episode is the first abnormality noted by the patient.

Many tracheal tumors invade the peritracheal tissue and mediastinal lymph nodes. Because

Tumors of the Trachea

Case	Sex	Age, Yr.	Situation	Grade	Treatment	Result
			Group 1. Squamous Cell Carcinoma			
1	F	59	Lower third	1	Diathermy	Alive ?
2	M	46	Lower third	3	0	Died in 2 months *
3	F	29	Lateral wall	2	Diathermy, radium	Alive after 9 years
4	F	38	Upper third	4	Roentgen rays	Alive after 6 months
5	M	52	Lower third	4	Roentgen rays	Died in 6 months
6	M	54	Lower third	3	Diathermy, roentgen rays	Alive after 1 year
7	F	42	Lower third	3	Radium	Died in 3 months
8	M	51	Entire trachea	4	Diathermy	Died in 6 months
9	M	46	Lower third	2	Radium	Died
10	M	40	Lower third	3	Diathermy, roentgen rays	Died
11	M	50	Lower third	3	0	
			Group 2. Cylindroma			
12	F	61	Upper third	..	Radium	Alive after 6 months
13	M	50	Upper third	..	Radium	Died in 10 years
14	F	34	Upper third	..	Laryngectomy	Alive after 5 years
15	M	70	Lower third	..	Roentgen rays, radium	Alive after 10 years
16	M	35	Middle third	..	Diathermy	Alive
17	F	32	Upper third	..	Roentgen rays	Alive after 5 years
18	M	49	Lower third	..	Diathermy, roentgen rays	Alive after 3 years
19	M	34	Upper third	..	0	Alive after 3 years
			Group 3. Adenocarcinoma			
20	M	45	Lower third	1	Roentgen rays	Alive after 16 months
21	M	57	Lower third	3	0	Died
22	F	48	Upper third	4	Roentgen rays	Died in 4 months
23	F	46	Bifurcation, trachea	4	0	Died in 1 month
24	F	43	Lower third	4	Roentgen rays	Died in 9 months
25	F	36	Lower third	4	Roentgen rays	Died in 10 months
			Group 4. Hemangioendothelioma			
26	M	62	Upper third	..	Roentgen rays	Died in 4 months
27	M	64	Lower third	..	Diathermy	Alive after 19 months

* In this column time is reckoned from the date on which the diagnosis was made.

s observed that a wheeze is usually present for long time before dyspnea develops. In our ies dyspnea was associated with wheeze or idor in 17 cases (63 per cent).

Cough was an important symptom in 15 cases 6 per cent). Since cough is caused by the chanical irritation of the trachea, it is nonpro- ctive at onset, but as the lesion enlarges, caus- g more tracheal obstruction with secondary in- tion of the retained secretions, the cough be- mes productive. In 12 cases (44 per cent) ugh was associated with hemoptysis, which ried from slight streaking of the sputum with ood to profuse hemorrhage. In 2 cases the sion was so necrotic that pieces of the tumor re expectorated.

the lymphatic drainage of the trachea is closely related to the recurrent laryngeal nerve anatomically, hoarseness is fairly frequently an important symptom. Hoarseness occurred in 8 cases (30 per cent) and 2 of our patients had aphonia. Involvement of the mediastinum may also cause obstruction of the return of venous blood, producing distention of the veins of the head and neck. Extension of the tumor into the esophagus is fairly common when the growth involves the posterior wall of the trachea. Dysphagia may then become the outstanding symptom. This occurred in 4 of our cases, and in 1 instance a tracheoesophageal fistula developed. Cervical lymph nodes may also be involved by metastasis.

DIAGNOSIS

Although routine roentgenographic studies may be of little importance in establishing the diagnosis, tomographic studies are often of considerable value. Roentgenograms taken after instillation of iodized oil into the trachea help fairly frequently to show the outlines of the lesion and may often lead to the correct diagnosis. Sometimes the tumor may be seen on direct laryngoscopy. In most cases of carcinoma of the trachea however, the diagnosis is dependent on bronchoscopic examination. The appearance of carcinoma of the trachea varies considerably. The lesion may be flat and infiltrating, or it may be polypoid and pedunculated. Confirmation of the diagnosis, of course, depends on the microscopic examination of tissue removed at the time of bronchoscopy.

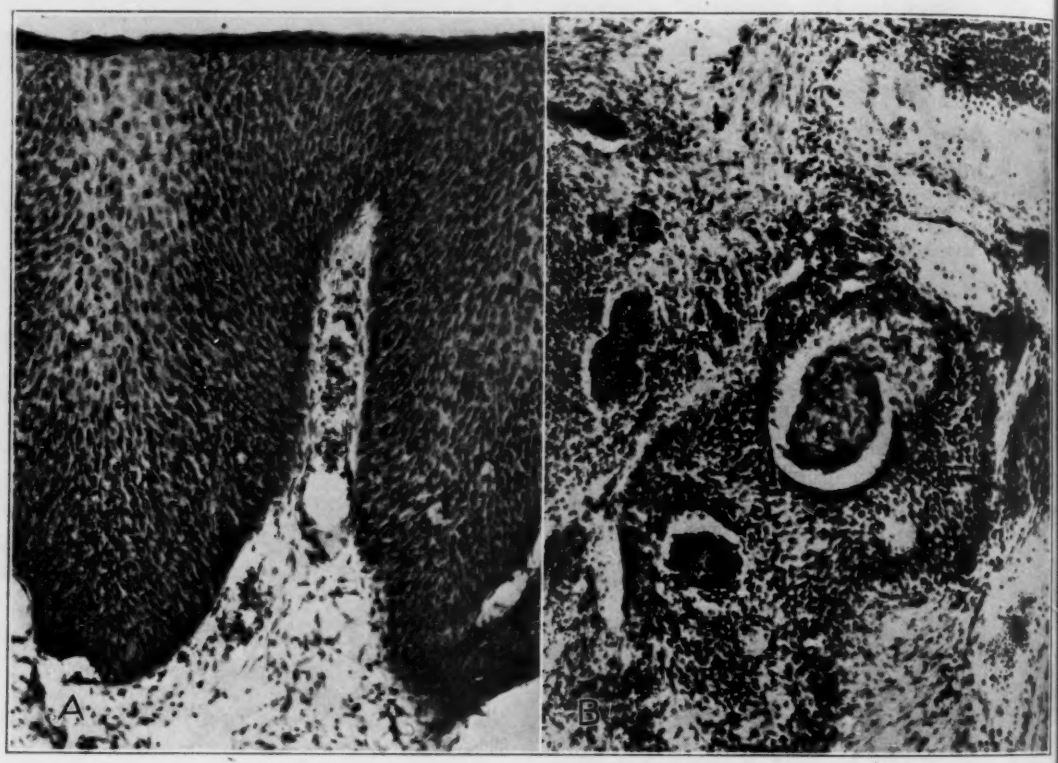


Fig. 1.—Squamous cell carcinoma of the trachea. *A*, carcinoma of grade 1, "in situ" type (case 1); hematoxylin and eosin; × 125. *B*, carcinoma of grade 3, infiltrating type (case 6); hematoxylin and eosin; ×

PATHOLOGIC CONSIDERATIONS

The pathologic diagnoses in the entire series of 27 cases are listed in the table. The tumors were divided into four distinct groups.

Group 1: Squamous Cell Carcinoma.—This comprised the largest group of the malignant neoplasms of the trachea, consisting of 11 tumors (41 per cent). These tumors are subdivided into two distinctive types, those which were papillary or "in situ" on histologic examination (fig. 1 *A*) and those which were infiltrative (fig. 1 Eight of the lesions were of the nonpapill type; 2 were of the papillary type, and the maining tumor, although it exhibited papill characteristics, was also infiltrative in type. tumors were graded according to Broders' cla fication, in which tumors of grade 1 are the l malignant and those of grade 4 are of the hig degree of malignancy, based on cellular crite It was found that the life expectancy for pati who had tumors of grade 1 or 2 was somew better than that for patients who had tumors grade 3 or 4 malignancy.

Group 2: Cylindroma.—Eight tumors co prised the second largest group of neoplasms volving the trachea. Cylindroma was first scribed by Billroth [8] in 1856 as a neoplasm co posed of cylinders of connective tissue int spersed with strands of tumor cells. A seco form of cylindroma was described by von Ohle in 1893, in which the neoplastic cells form cylinders of mucous material. All the tumo diagnosed as cylindroma in the present ser were of the latter type.

Morphologically, the cells comprising ne plasms of the cylindroma type were small a fairly regular. Mitoses were scarce. The ce grouped themselves into the form of an acin

8. Cited by Ewing, J.: Neoplastic Diseases, Phi delphia, W. B. Saunders Company, 1928, p. 332.

losing a small lumen (fig. 2). The lumen tained mucus, as evidenced by the mucicar- e stain; however, this mucus rarely stained deeply with the carmine as does the mucus med by ordinary mucus-producing adeno- cinoma or that produced by the epithelium of gastrointestinal tract. With polychrome thylene blue stain this mucus stained a bril- t red. In this respect again the mucus is un- ordinary mucus, which stains hardly at all h polychrome-methylene blue. Between the ups of cylindroma cells, a small amount of linized connective tissue was present.

n 2 cases of cylindroma in this series there s definite evidence of peritracheal extension.

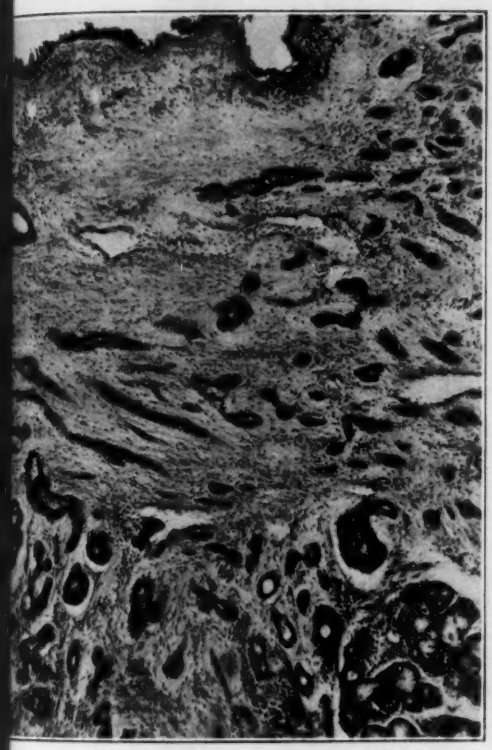


Fig. 2.—Cylindroma of the trachea (case 19); hema- ylin and eosin; × 45. Note the intact mucosa.

the first (case 17) a piece of tracheal cartilage s removed in the biopsy specimen, which on croscopic examination clearly demonstrated plastic cells outside the cartilage (fig. 3 *A*). the second case (case 19) the growth had in- ded the thyroid gland (fig. 3 *B*). Whether or peritracheal extension was present in the re- ining cases, it is impossible to say in the ab- ce of surgical exploration. In none of the es of cylindroma was there demonstrable evi- nce of metastasis. Histologic grading accord- g to Broders' classification was not utilized in s group because there was little if any variation the degree of cellular activity when one tumor s compared with another.

Cylindroma is sometimes confused with bronchial adenoma. Cylindroma, however, presents an entirely different histologic picture from that of bronchial adenoma. It tends to produce mucus, which adenoma does not. The use of a mucicarmine stain should enable one to distinguish the two types of tumor. Adenoma is much more vascular than cylindroma. In none of the cases of cylindroma in our study did this tumor correspond in histologic appearance to adenoma of the bronchus.

Mixed tumor also may be mistaken occasionally for cylindroma. Distinction between these two should, however, offer little difficulty because the mixed tumor has, in addition to epithelial elements, connective tissue which is undergoing myxomatous change and constitutes part of the neoplasm. Cylindroma occasionally shows this second characteristic. There were no mixed tumors among the present series of tracheal tumors.

From a therapeutic standpoint, cylindroma is the most satisfactory of the several types of tracheal tumor to treat. This is well illustrated in the table. However, in view of the tendency of this type of tumor to extend, and since it is known to metastasize from other primary sites where it arises, it should be looked on as slowly growing adenocarcinoma of the cylindroma type.

Group 3: Adenocarcinoma.—In 6 of the cases the tumor was of adenocarcinomatous type. In case 20 the tumor was a glandular neoplasm showing different characteristics from the others. It appeared to be making good glands; the cells making up this tumor were small and regular. Mitoses were scarce. It appeared to be a carcinomatous lesion comparable in malignancy to adenomatous polyps of the colon (fig. 4 *A*). It did not show the structure shown by cylindroma. In the remaining 5 cases the tumor was a very anaplastic small cell carcinoma (fig. 4 *B*). In 4 of the 5 definite gland formation was not evident. It might be argued that these are not cases of adenocarcinoma but it is a well known fact that adenocarcinoma arising from a glandular organ notoriously shows small cells often without glandular formation. Such an appearance is often seen in the linitis plastica type of carcinoma of the stomach and scirrhous carcinoma of the breast.

In case 20 the tumor was of low grade malignancy. In the remaining cases the tumor was of high grade malignancy (3 or 4). This is reflected in the survival rates in that the only survival in this group was in case 20.

Group 4: Hemangioendothelioma. — There were 2 cases of hemangioendothelioma or angioblastoma—malignant neoplasms of blood vascu-

lar origin. In both of the neoplasms in this group the tumor cells showed the typical tendency to form vessels (fig. 5); a few mitotic figures could be demonstrated in these cells. The neoplastic cells showed fairly regular nuclei. By analogy with similar neoplasms elsewhere in the body, one could suggest that both of these neoplasms were slowly growing and consequently that the prognosis would be good. Actually, too few goblet cells. Beneath this there are mucus-p ducing tubuloalveolar glands, which drain t secretions to the tracheal lumen. These are n numerous in the membranous portion of trachea and in the portion between the carti inous rings. Hyaline cartilage, smooth mu and the tunica propria, containing connective sue, vessels and nerves, complete the list of sues in the trachea. The fact that the epithel

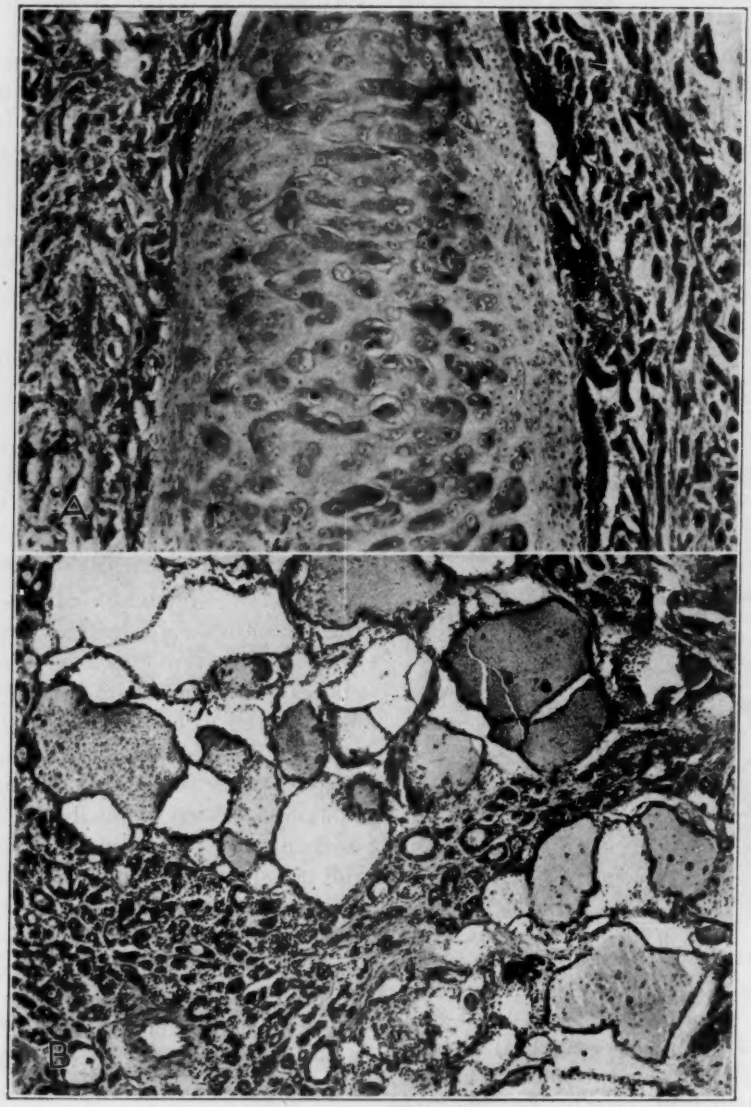


Fig. 3.—Cylindroma of the trachea. *A*, section from case 17; hematoxylin and eosin; × 135. There is ex sion on both sides of the tracheal cartilage. *B*, section from case 19; hematoxylin and eosin; × 55. growth has invaded the thyroid gland.

cases of this type were observed to enable one to draw conclusions.

Histogenesis.—In order to hypothesize how these various neoplasms of the trachea arise from the existing cells in the trachea, it is necessary to review the normal histology of this organ. The mucous membrane of the trachea is a stratified ciliated epithelium in which are embedded lining the trachea can give origin to two differ types of carcinoma is evidence in favor of contention of Kettle[9] and Broders[10] that

9. Kettle, E. H.: On Polymorphism of the Ma nant Epithelial Cell, Proc. Roy. Soc. Med. **12:** (April) 1919.

10. Broders, A. C.: Squamous-Cell Epitheliom the Skin: A Study of Two Hundred and Fifty Cases, Ann. Surg. **73:**141-160 (Feb.) 1921.

thelial cell is polymorphic. Furthermore, it is necessary for ciliated epithelium such as is nd in the trachea to give rise to benign squa- us epithelium in order for squamous cell cinoma to develop. The carcinoma usually ginates from the undifferentiated epithelium then differentiates to glandular or squamous mucous glands are present: the upper part of the respiratory tract, the salivary glands and so forth. Another fact supporting the origin of cylindroma from glands is that the surface epithelium over the tumor is usually intact.

Hemangioendothelioma probably originates from the vessels in the tracheal wall.

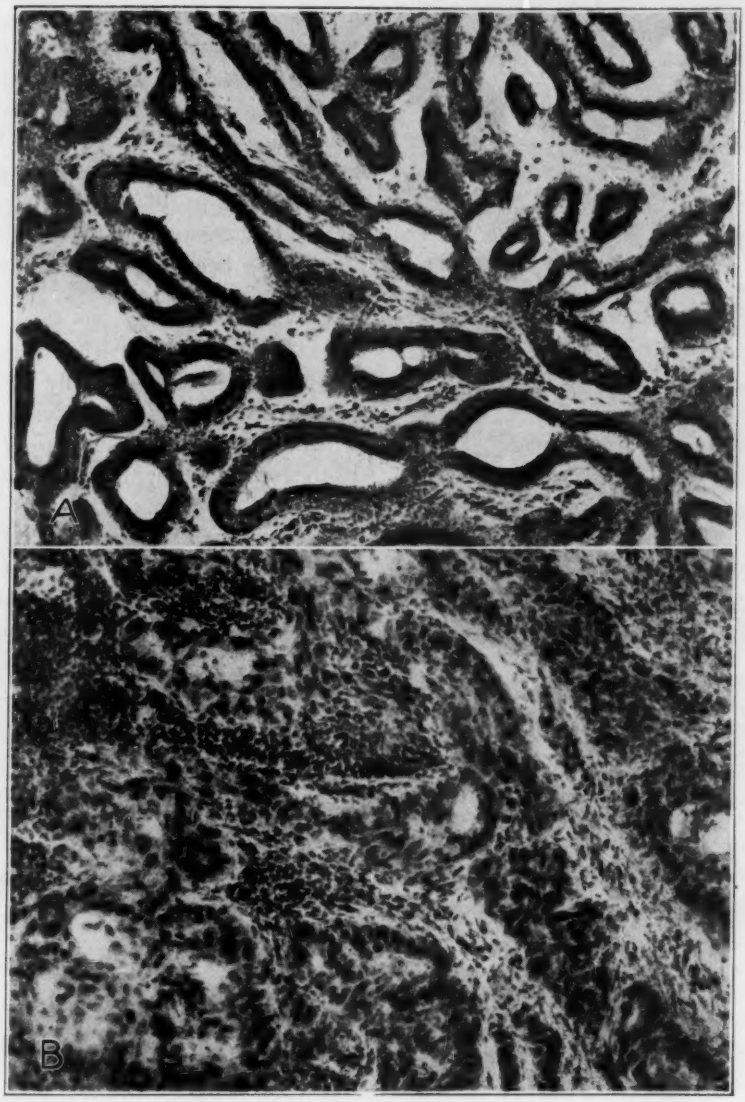


Fig. 4.—Adenocarcinoma of the trachea. *A*, grade 1 (case 20); hematoxylin and eosin; × 100. Note the well rmed glands. *B*, grade 3 (case 21); hematoxylin and eosin; × 145. There are poorly formed glands with arked hyperchromatism of the carcinomatous nuclei.

ll type. This process, either in its benign or in s malignant form, is commonly known as meta- asia. It is not a rare thing to observe this proc- s in the bronchus, the epithelial lining of which similar to that of the trachea.

Cylindroma probably takes its origin from the lls lining the mucous glands rather than from e surface epithelium. It is found almost clusively in regions of the body where the

TREATMENT

Carcinoma of the trachea offers an extremely difficult therapeutic problem, and no one form of treatment has been found satisfactory in all types of cases. Carcinoma situated in the upper portion of the trachea is best handled by means of tracheal fissure and destruction of the tumor by electrocoagulation as advocated by Figi.[8] After destruction of the tumor, a large tracheot-

omy tube is left in the trachea, and the site of the tumor can be inspected at frequent intervals for possible evidence of recurrence.

Surgical resection of a portion of the involved trachea has been advocated by various observers,

Fig. 5.—Hemangioendothelioma of the trachea (case 26); hematoxylin and eosin; × 100. The neoplastic cells are forming with few vascular spaces. The overlying epithelium is intact.

but this carries a much higher operative risk than tracheal fissure, and the results obtained have not been as satisfactory as the results of tracheal fissure and destruction of the tumor by electrocoagulation. In addition surgical res tion leaves the patient with a marked disabi which may lead to subsequent difficulty.

Carcinoma situated in the lower end of the t chea is best treated by electrocoagulation of tumor through the bronchoscope. The implan tion of radon into the tumor has been emplo rather extensively with questionable benefit. does seem advisable, however, to employ radium pack or roentgen rays over the regio lymph nodes. In a case of our series in wh adenocarcinoma of the trachea was extensive could not be treated adequately by means of s gical diathermy, the use of roentgen therapy al was followed by marked benefit.

The best results from the therapeutic sta point have been obtained in the cases of cyl droma.

PROGNOSIS

Since the lesion is usually far advanced bef a correct diagnosis is established, the progno of tumor of the trachea is poor. In most ca death is caused by tracheal obstruction, sec dary pulmonary suppuration or hemorrhage. though the life expectancy of most patients is tween six months and one year, there are so notable exceptions. This is particularly true tumors of the cylindroma group, as shown in table. In our series of 27 cases there were 8 cylindroma. One of the patients with this t of tumor died ten years after the diagnosis, parently of an entirely unrelated disease. other 7 were living and well when last hea from. Three patients for whom the diagnosis cylindroma had been made were asymptomatic least five years after the diagnosis had b established.

LYMPHOID HYPERPLASIA OF THE NASOPHARYNX

A STUDY OF ONE HUNDRED AND THIRTY-ONE AUTOPSY SPECIMENS

A. R. HOLLENDER, M.D., AND PAUL B. SZANTO, M.D.
CHICAGO

Since Waldeyer [1] first described the lymphatic paratus of the pharynx, various concepts con- ning the development and involution of the mphatic tissue of this organ have been pre- ted. The one most commonly accepted is so-called craniocaudal development of Wal- er's ring (fig. 1).

CRANIOCAUDAL DEVELOPMENT AND INVOLUTION

According to this concept, the developmental d involutional changes of the lymphatic appa- us occur in the same sequence. A complete scription must necessarily embrace the naso- aryngeal, tubal, palatine and lingual tonsils. The development of the nasopharyngeal and al tonsils begins after birth and attains its k between the second and third years of life. puberty the involution of these structures erally approaches completion. The develop- nt of the palatine tonsils may begin early in ncy but usually later than that of the naso- aryngeal and tubal tonsils. The involution of palatine tonsils is observed in the majority persons after the fourth decade of life. The gual tonsils comprise the final link in Wal- er's ring and exhibit maximum development adults at about this same period. In elderly sons the lingual tonsils are usually well pre- ved.

Because of the sequence in which the develop- ntal and involutional changes occur, the naso- aryngeal and tubal tonsils first and the lingual sils last, the term "craniocaudal development d involution of Waldeyer's ring" was coined. The material for the present study consisted autopsy specimens. Since they presented a mber of variations from the common teach- s, it immediately became obvious that there s considerable practical value in the informa- n to be derived from this investigation. It is of course impossible to include in a brief report the results of the entire study.

In the main, the purpose of this paper is to point out the frequent incidence of hyperplasia of the nasopharyngeal or the tubal tonsils or both in adults, especially in older persons. Because of the close interrelationship of structures, other parts of Waldeyer's ring have had to be included in this discussion.

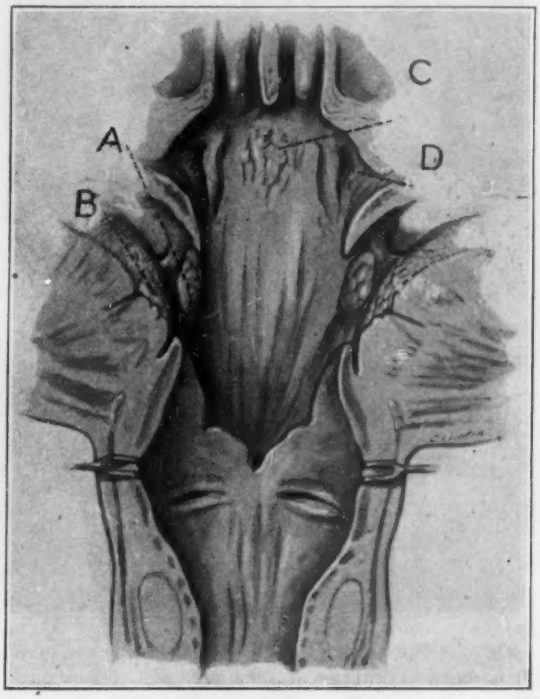


Fig. 1.—Waldeyer's ring (semischematic): *A*, palatine tonsil; *B*, lingual tonsil; *C*, nasopharyngeal tonsil; *D*, tubal tonsil.

BRIEF REVIEW OF THE LITERATURE

Only a brief survey of the literature has been attempted. Pertinent references have been drawn, dealing with the clinical and pathologic aspects of the problem.

From the clinical aspect some of the earlier reviews are of interest. Hopmann,[2] in 1895,

From the Department of Laryngology, Rhinology Otology, University of Illinois College of Medi- , and the Department of Pathology, Chicago and lakee State Hospitals.

1. Waldeyer, W.: Der lymphatische Rachenring, tsche med. Wchnschr. **10**:313, 1884.

2. Hopmann, C. M.: Die adenoiden Tumoren als Teilerscheinung der Hyperplasie des lymphatischen

(Footnote continued on next page)

cited a case described by Solis Cohen of hyperplasia of the nasopharyngeal tonsil in a woman 70 years of age. Ephraim,[3] in 1899, likewise described hyperplasia of the nasopharyngeal tonsil in a woman 67 years of age. Frank,[4] in 1906, reported on nasopharyngeal tonsillar hyperplasia in 3 persons ranging from 60 to 66 years of age. Chiari,[5] in his textbook published in 1903, made the general statement that hypertrophy of the nasopharyngeal tonsil may occur in persons over 60 years of age. Since these earlier reports several foreign and American authors have concurred in the views, but only in a very few instances have the statements expressed been substantiated by specific studies.

Fig. 2.—Specimen from a woman 75 years of age: *A*, nasopharyngeal tonsil showing marked hyperplasia; *B*, septum nasi; *C*, posterior wall of the pharynx; *D*, epiglottis.

From the pathologic side one must pay regard to the observations of Mathias[6] in consecutive autopsy specimens. He found the nasopharyngeal tonsil begins its developm immediately after birth and in most insta shows involution at the time of puberty. studies disclosed also that the tubal tonsils velop somewhat later and attain involution a puberty. They may, in fact, be well develo in middle-aged persons. The palatine ton according to Mathias, develop in early c hood, approach their peak about puberty attain involution with increase of age. lingual tonsils develop later than the pala tonsils. This author expressed the view, rectly, that hyperplasia of the nasopharyn

Distribution of the Stages of Development and In tion of Lymphatic Tissue (Waldeyer's Ring) i One Hundred and Thirty-One Autopsy Specimens According to Age Groups

	20-35	35-50	50-65	65-75
Nasopharyngeal tonsil				
Completely involuted	5	10	35	30
Partially involuted	2	4	7	8
Moderately well developed	..	..	2	1
Well developed, hyperplastic	3	1	1	1
Tubal tonsil				
Involuted	8	12	42	39
Partially involuted	..	1	2	..
Moderately developed	1	..	1	1
Well developed, hyperplastic	1	2	..	..
Palatine tonsil				
Involuted or very small	1	1	4	4
Small or moderately developed	6	12	37	34
Hyperplastic	3	2	4	2
Lingual tonsil				
Moderately developed	8	14	37	36
Well developed, hyperplastic	2	1	8	4

tonsils may occur independently or may part of a general hyperplasia of the entire The results of Mathias' investigations con Gräff's hypothesis concerning the craniocau development and involution of the lymp structures of Waldeyer's ring.

DATA FROM STUDIES OF AUTOPSY SPECIMENS

As has already been stated, the observat forming the basis for this report were made autopsy material. This is mentioned bec they vary from those made on clinical exam tion. One hundred and thirty-one adult sp mens were available for gross or microsc

Rachenringes und in ihren Beziehungen zum übrigen Körper, Halle a. S., K. Marhold, 1895; Samml. zwangl. Abhandl. a. d. Geb. d. Nasen-, Ohren-, Mund- u. Halskr., 1895, vol. 1, no. 5-6.

3. Ephraim, E.: Casuistische Mittheilungen, Monatschr. f. Ohrenh. **33**:198, 1899.

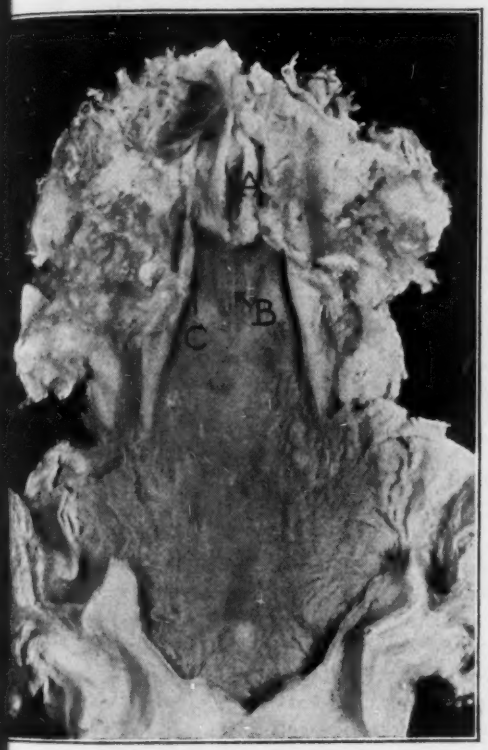
4. Frank, P.: Hypertrophische Rachenmandeln bei Greisen, Arch. f. Laryng. **18**:285, 1906.

5. Chiari, O.: Die Krankheiten des Rachens, Leipzig, F. Deuticke, 1903.

6. Mathias, W.: Ueber den Entwicklungsgang Waldeyerschen Rachenringes, Beitr. z. path. An z. allg. Path. **94**:389, 1935.

dy or both. At autopsy the nasopharynx removed so that its relationship to important hboring structures was not disturbed. Every imen included Waldeyer's ring or its rem-ts.

The accompanying table details the incidence partial and of complete hyperplasia of the phoid structure of Waldeyer's ring accord- to different age groups. It is of special rest to note the incidence of hyperplasia of nasopharyngeal tonsil in persons past 70 rs of age. Figure 2 is that of a specimen a woman 75 years of age, showing marked erplasia of the nasopharyngeal tonsil but in-



g. 3.—Specimen from a man 69 years of age: *A*, m nasi; *B*, deep median recess; *C*, adhesion in nmüller's recess on the right.

tion of the palatine tonsils and moderate elopment of the lingual tonsils. This is in t with Mathias' observation previously men-ed that hyperplasia of any one structure in ldeyer's ring does not necessarily imply that imilar change has taken place in the other phoid structures.

Histologic examination of numerous sections ealed large numbers of follicles with germina- centers. The follicles were separated from another. The lymphoid tissue of the mucosa covered by ciliated columnar epithelium. In some instances small cystlike structures were present. The cysts were lined with columnar epithelium. From this description it may be assumed that the morphologic picture of nasopharyngeal lymphoid hyperplasia of adults is practically the same as that of adenoid vegetations of childhood.

Hyperplasia of the tubal tonsil was found less frequently in our specimens than hyperplasia of the nasopharyngeal tonsil. There were only 4 specimens of the tubal tonsil presenting hyperplasia, compared with 9 specimens of the nasopharyngeal tonsil (see the table).

Partial involution of the nasopharyngeal tonsil was a common observation. After complete involution a deep median recess may remain (fig. 3). This should not be confused with a nasopharyngeal bursa.

COMMENT

Hyperplasia of the nasopharyngeal tonsil in adults is not always associated with clinical symptoms. Two factors commonly influence the production of symptoms: (1) infection; (2) size of the nasopharyngeal vault. The latter is the more important factor. Obviously, if the vault is large, so that no pressure results from the hyperplasia of the contained lymphoid tissues, symptoms of obstruction will be absent. If, on the other hand, the nasopharyngeal space remains in an infantile stage because of developmental obstacles, or the anterior-posterior diameter is diminished because of protrusion of the anterior arch of the atlas, there will be inevitable crowding of the contents of the vault with definite symptoms of pressure.

Unilateral or bilateral hyperplasia of the tubal tonsils is significant because of its relationship to the ostiums of the eustachian tubes. It has been insufficiently appreciated as a factor in the hearing impairment of older persons, although it frequently accounts for certain types of obstructive deafness in children.

In all cases of hyperplasia of the nasopharyngeal and tubal tonsils there seems to be no relationship between the hyperplasia of these structures and the extent of development of the lymph nodes, the lymphatic tissue of the spleen and Peyer's patches in the intestines. Furthermore, there seems to be no correlation between hyperplasia of the nasopharyngeal lymphoid tissue and general pathologic conditions.

This study does not undertake to express any conclusive opinions concerning the functional aspects of lymphoid tissue. However, the fact that

nasopharyngeal lymphoid tissue commonly recurs after attempted complete removal suggests, in our opinion, that this tissue possesses some definite function. Why in some adults the lymphoid tissue of Waldeyer's ring shows involution at an early age and hyperplasia at a later period in life, even as late as the eighth decade, is a question which for the present must remain unanswered. And finally, there is no sound explanation for the stages of development of the different parts of Waldeyer's ring.

CONCLUSIONS

1. There is no general rule regarding the involution of lymphoid tissue in Waldeyer's ring.

2. Hyperplasia of the nasopharyngeal to is not a rare occurrence in adults; the incide of hyperplasia of the tubal tonsil is less frequ

3. The nasopharyngeal tonsil may be the o structure in Waldeyer's ring presenting hyp plastic changes.

4. There is no correlation between the st of development of the nasopharyngeal tonsil other pathologic processes in the body.

5. It is reasonable to assume that cert constitutional factors are responsible for va tions in the development and involution of different parts of Waldeyer's ring.

307 North Michigan Avenue.

Case Reports

THROMBOSIS OF A CAVERNOUS SINUS TREATED WITH PENICILLIN AND HEPARIN

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MEDICAL CORPS, ARMY OF THE UNITED STATES

ure of thrombosis of a cavernous sinus prior he advent of sulfonamide compounds was ptional. Schall [1] advocated the combined of heparin and chemotherapy, with a resultant ease in the number of cures over that with use of sulfonamide compounds alone. In case to be reported, in which sulfadiazine arently was not benefiting the patient, imme- e and marked improvement resulted from use of penicillin and heparin in the presence Staphylococcus aureus infection.

REPORT OF A CASE

white man aged 25 entered a regional station hos- on Feb. 28, 1944 with a diagnosis of cellulitis of the His chief complaint was swelling of the nose for days. Ten days before entry he contracted a d," with nasal discharge and stuffiness. There was istory of trauma. On the day before admission he seen as an outpatient, and an impression of herpes lex of the upper part of the left and right nasal bules was recorded. Later that day the patient d that he felt alternately feverish and chilly.

e past history revealed that the patient had typhoid pneumonia in 1929 and malaria, uncomplicated, in The family history and other medical history not pertinent.

n entrance into the hospital he had marked indura- of the upper portion of the nose, especially on the , involving the bridge of the nose, with edema of ight eyelid. No signs of abscess formation were rved. The skin in this area was tense and bluish and it was not sharply delineated from the normal unding tissue. Cellulitis of the nose with possible nding thrombosis of the cavernous sinus as a plication of the preceding herpes was the impres- at the time of his admission. The temperature his time was 98.6 F., the pulse rate 90 and the ratory rate 20.

inical Course.—Sulfadiazine therapy was begun on day of hospitalization, magnesium sulfate com- es were applied to the nose, and sedation was n. In spite of 9 Gm. of sulfadiazine in eighteen s, the temperature rose to 103.4 F. and the pulse to 120. The dosage of sulfadiazine was changed Gm. every four hours. At this time the mag- m sulfate compresses were changed to boric acid ntations, and sulfathiazole ointment was used locally.

On the second day of hospitalization, February 29, a crust was removed from the nose and much pus exuded. Material was taken for culture, which yielded a growth of Staphylococcus albus. Blood cultured this day gave a growth of Staphylococcus aureus. The ocular fundi were normal. The blood vessels were not dilated. Physical examination at this time gave the same results as previously. The pupils of the eyes were equal and reacted to light and accommodation. Upward movement of the right eye seemed limited, and attempts at this movement caused diplopia. The upper lip showed scattered herpes. The pharynx was moderately congested. No rigidity or adenopathy of the neck was noted. The heart, the lungs and the abdomen were normal. A positive Babinski sign was obtained on the left side. The left knee jerk was sluggish; the right was not obtainable.

On the third hospital day the patient became stuporous but could be aroused. In the course of twelve hours he vomited about 18 ounces (532 cc.) of the gastric content. Redness and swelling of the nose and of the right orbital region progressed, and the left orbital region became involved to a lesser degree. Some chemosis of the right eye was present, but no proptosis. The temperature rose to 106 F., the pulse rate to 120 and the respiratory rate to 36. The blood sulfadiazine level was 6.7 mg. per hundred cubic centimeters of blood. Blood taken for culture this day again gave a growth of Staph. aureus. Since the patient did not appear to be responding to sulfadiazine therapy and became more toxic and stuporous, 10,000 units of penicillin was given intramuscularly and 90,000 units of penicillin intravenously, diluted in 1,000 cc. of isotonic solution of sodium chloride containing dextrose. Later, on the same day, intravenous injection of heparin was begun. That night another 100,000 units of penicillin was given intravenously, and the temperature began to drop. By this time the patient was unable to open either eye because of edema, but he had no pain and complained only of being tired.

By the sixth day the temperature had dropped to 101.6 F. On the following day, March 5, a chill developed, and his temperature rose to 104.8 F. The patient's general condition was about the same; he still was somewhat stuporous. One hundred and twenty thousand units of penicillin had been given daily intravenously, but, because of slight hemorrhage from ulcers on the lip and the nose, the heparin had been temporarily discontinued.

The patient began to show some signs of improvement as early as the fifth day of hospitalization, and intramuscular administration of penicillin therapy, 20,000 units every four hours, was substituted. He was able to speak well and said that he felt better that

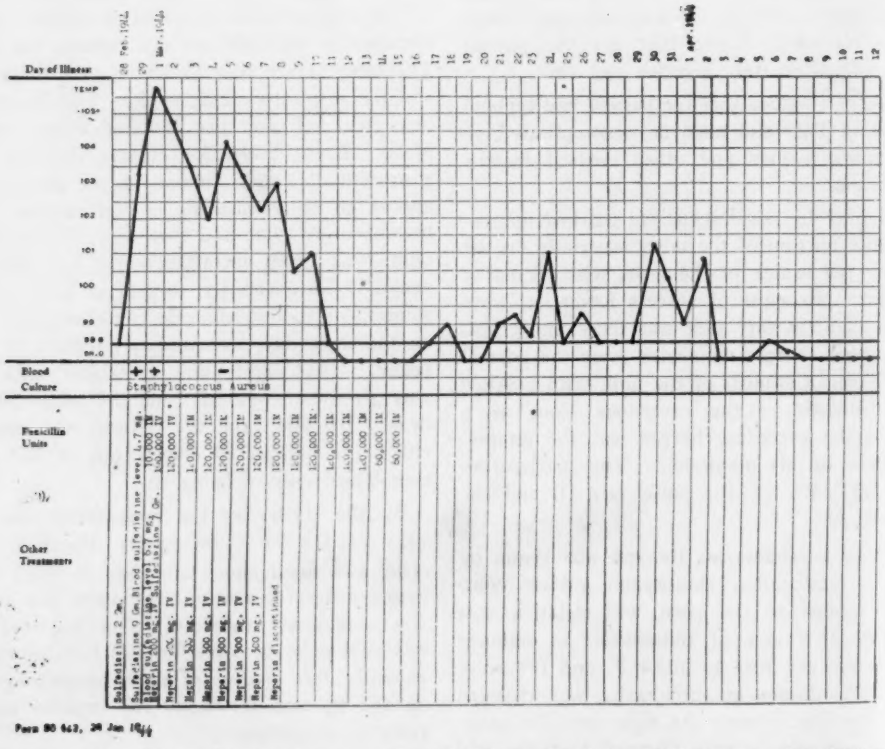
1. Schall, L. A.: Treatment of Septic Thrombophlebitis of the Cavernous Sinus, J. A. M. A. **117**:581 (Aug. 23) 1941.

morning. Considerable swelling of the face and of the eyelids was still present; however, the redness of the nose and the eyelids was less. At noon of that day heparin therapy was begun again. The right orbit was still immobilized; however, there were some movements

Apart from the complaint of headache on coughi moving and a tired feeling, the patient seemed i condition. Blood drawn for culture on the seven of hospitalization and five days after the institu penicillin therapy showed no growth of orga

Clinical Observations on a Patient with Thrombosis of a Cavernous Sinus Who Was Treated wi Penicillin and Heparin

		Blood							
				Differential Count, per Cent					
Date, 1944	Urinary Albumin	Red Cells	White Cells	Polymorphonuclears	Monocytes	Hemoglobin, per Cent	Blood Clotting Time, Min.	Blood Sedimentation Rate, Mm. per Hour	Spinal Fl
February 28	None	.....	12,450	81	1	80	18		
March 1	++++	4,250,000	8,800	88	2	80			
March 2	++	.....	.....	..	..	..	20		
March 3	Trace	.....	13,450	91	5	..	10		
March 4	Trace	3,210,000	8,450	..	..	..	38		
March 5	None	3,890,000	12,300	83	2	85	30		
March 6	None	.....	16,500	..	..	..	28		
March 7	.....	.....	.....	..	..	..	51		
March 8	.....	3,670,000	19,950	75	5	80	6		
March 9	.....	.....	.....	..	..	..	4		
March 10	.....	4,150,000	15,800	79	5	..	2		
March 11	Trace	.....	11,400	..	..	..	2		
March 12	None	4,130,000	.....	75	2	..	..		
March 22	.....	.....	.....	..	..	..	..	66	
March 23	None	4,600,000	8,900	77	..	90	..	67	
March 31	None	.....	.....	..	..	..	..	79	
April 4	.....	.....	.....	..	..	..	..	0.5	Culture, neg globulin, sli crease; Was mann reacti negative; p curve 555553
April 7	.....	4,450,000	7,600	58	3				



Temperature curve correlated with the dosages of sulfadiazine, penicillin and heparin. *IM* indicates intr cular injection; *IV*, intravenous injection and the asterisk that 20,000 units was given every four hours.

of the left orbit. Gradually the patient began to show improvement. By the sixth day of hospitalization he began to talk better, look better and feel better. Some motion of the right eyeball was noticed at this time.

The ocular movements appeared to be greatly im by the ninth day. On the tenth day of hospitali the heparin infusions were discontinued, but the cillin therapy was continued. Throughout this

ocular fundi were essentially normal; the right disk slightly blurred; the veins were slightly tortuous within normal limits; no hemorrhages were seen. the twelfth day of hospitalization the external r movements were normal. Conjunctival edema hemorrhage were still present in both eyes. Dur- the entire course of the illness thus far, the patient little by mouth other than some carbonated bever- and occasional sips of milk or water.

n the thirteenth day of hospitalization, the patient's ue was noted to be markedly fissured and dry. In tion to increasing the amount of fluids, feeding of gh caloric, high vitamin diet was begun, and ribo- n, 5 mg. three times a day, and thiamine hydro- ride, 50 mg. daily, were given. The lesion of the ue responded rapidly to this treatment. On the nteenth day the penicillin therapy was discontinued. he next two weeks the patient complained of mild aches, which by the twenty-second hospital day e seriously annoying. About this time there was ccasional episode of vomiting, associated with head- . The sedimentation rate on the twenty-fifth day ospitalization was 67 mm. per hour. On this day temperature curve showed a spike reaching up to F., and again one week later. The administration hiamine hydrochloride was discontinued on the ty-seventh hospital day. The sedimentation rate he thirty-third day of hospitalization was 79 mm. hour. On the thirty-fifth day, because of the occa- l spiking of the temperature curve and repeated aches, studies of the spinal fluid were made. The sure was 151 mm., and on pressure of the left lar vein it rose to 272 mm. Pressure on the right lar vein caused a rise to 245 mm. Except for mild variation of jugular pressure from right to the dynamics of the spinal fluid pressure were ntially normal. An increase of 1 plus in globulin present, and no cellular elements were observed. colloidal gold curve showed the abnormal finding 5555531000. The Wassermann reaction was nega- The patient became afebrile on the thirty-sixth ital day, at which time the sedimentation rate was m. per hour. The blood count was 4,450,000 red blood and 7,600 white blood cells; the hemoglobin con- (Tallquist) was 90 per cent. The differential white count showed 58 per cent neutrophils, 39 per cent hocytes and 3 per cent monocytes. On the fortieth ital day we began to give polyvitamin capsules[2] in addition to riboflavin, the capsules being given three times a day. On the thirty-seventh hospital day the patient began to get out of bed and seven days later he was discharged to quarters. On the fifty-sixth day after admission he was returned to duty. At the time of writing, six months after onset, the patient is completely recovered.

[2] These capsules contained the following vitamins:

min A.....	2500 U. S. P. units (fish liver oils)
min D.....	200 U. S. P. units (viosterol)
min B_1.....	1.0 mg. (thiamine)
min B_2(G)....	1.5 mg. (riboflavin)
min C.....	37.5 mg. (ascorbic acid)
tinamide.....	10 mg.

In this patient herpes of the nose and upper lip developed, associated with a mild acute infection of the upper respiratory tract on which was imposed secondarily an infection with Staph. aureus. This infection spread and developed into cellulitis, which rapidly became spreading thrombophlebitis and septicemia. The thrombosis probably spread to involve the angular vein, thereby causing edema of the right orbit. This thrombosis apparently spread by way of the angular vein to involve the cavernous sinus. At this point the left orbit became edematous. This case fits the classic picture of thrombosis of the cavernous sinus except for the fact that only slight proptosis developed and no distention of the retinal veins ever became evident. A possible explanation of the failure of distention of the retinal vein to develop might be that the superior ophthalmic vein, into which the retinal vessels empty, might have been anomalous, having collateral connections to vessels such as the pterygoid plexus, thereby allowing continual drainage from the fundus. In this way the thrombosis could spread by way of the angular vein to the superior ophthalmic vein distal to the collateral circulation and thereby involve the cavernous sinus.

SUMMARY

In the case of a patient critically ill with thrombosis of a cavernous sinus secondary to Staph. aureus infection of the nose, treatment with sulfadiazine was without apparent response. Treatment with penicillin and heparin was then instituted, with cure. Heparin seemed to enhance the availability of the penicillin by maintaining an increased blood coagulation time. The response to penicillin in this Staph. aureus infection suggests the possibility of more cures for the group of organisms which are resistant to treatment with the sulfonamide compounds.

BILATERAL CONGENITAL ATRESIA OF THE CHOANAE

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MEDICAL CORPS, ARMY OF THE UNITED STATES

Occasional cases of this rare anomaly are reported in the literature, and today the condition is not too unfamiliar to physicians. However, as noted by Kazanjian,[1] the reports of these cases mention adenoidectomy, septal resection and surgical opening of sinuses, which suggests that the true condition had escaped diagnosis.

In the case to be described, the presenting symptom was snoring, which happened to be of such severity as to inconvenience seriously other members within the barracks. All of the points mentioned by Kazanjian [1] as helpful in making the diagnosis were present: (1) On inspection the nose presented no obvious clearcut cause for obstruction, (2) there was no profuse collection of clear mucus on the floor of the nose, (3) a small rubber catheter could not be passed through either nostril into the nasopharynx, (4) the choanae on inspection with a nasopharyngoscope and with a postnasal mirror presented a typical picture and (5) a roentgenogram of the nose filled with an opaque oil was diagnostic (fig. 1).

Relief of this obstruction was undertaken the intraoral route, and the procedure was follows:

Local anesthesia was secured by injecting 1 per cent solution of procaine hydrochlor along the midline of the soft palate. The p terior portion of the septum and the floor the nose posteriorly were also infiltrated w this solution. The soft palate was retrac forward and the nasopharyngeal vault spra with a 2 per cent solution of tetracaine hyd chloride. The nasal chambers were also spra with the latter solution. An incision was m through the midline of the soft palate. It split, and retraction was obtained by inser heavy silk traction sutures. The choanal atr could now be palpated by the postnasal ro The index finger was then used as a guide, an antrum-pointed round rasp was employe perforate the bilateral bony occlusions enc tered in this case. Both of the openings w enlarged by rasping in a forward, medial lateral direction, care being taken to avoid tra posteriorly and possibly hemorrhage from sphenopalatine artery. A large rubber cath was inserted through and through the open

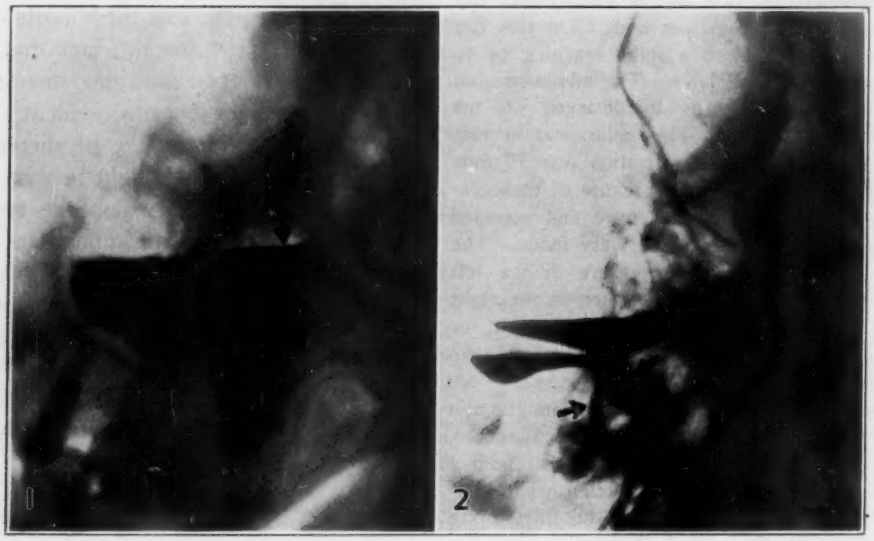

Fig. 1.—Section of a roentgenogram (July 8, 1943) revealing iodized poppyseed oil 40 per cent to be s nant in the nasal cavity.

Fig. 2.—Section of a roentgenogram (July 28, 1944) revealing passage of iodized oil through the cho apertures.

1. Kazanjian, V. H.: Treatment of Congenital Atresia of Choanae, Ann. Otol., Rhin. & Laryng. **51**:704-711 (Sept.) 1942.

d allowed to remain in place for ten days or to removal. The soft palate was then ured together and approximated in the mid- e. The openings were patent one year later g. 2), and at this time the patient was read- tted for surgical removal of the osseous bridge. is was accomplished under local anesthesia cutting through with a Gigli saw. This step ld advantageously be performed during the ial procedure rather than dividing the opera- n into two stages, as it creates a single wide terior chamber.

REPORT OF A CASE

. K., aged 26, was first seen in the otolaryngologic patient clinic, Aug. 18, 1943, complaining principally snoring and inability to breathe through his nose. stated that between the ages of 5 and 10 years he erwent two operations for the correction of this dition. The adenoid type of facies was striking, was also the tremendously exaggerated arch of the d palate. When the patient closed his mouth and athed through the nostrils, it was noted that air uld not pass through into the nasopharynx. Nasal mination revealed a very slight deviation of the tum to the left, a pale atrophic scarred mucous mbrane and an accumulation of clear tenacious mu- secretion on the floor of the nasal chambers. Neither a small rubber catheter nor a filiform would pass through either side of the nose into the naso- pharynx. Examination with a nasopharyngoscope and a postnasal mirror revealed the bilateral congenital choanal atresia. Palpation with a metal probe revealed it to be osseous in type.

The pharynx, the larynx and the ears presented nothing unusual, and the hearing for whispered voice was 20/20 bilaterally. The systemic physical examination gave essentially negative results, and no other congenital defects were noted.

August 20 surgical correction was performed by the technic previously described, and the postoperative course was uneventful, with the patient returning to duty on September 9. An examination in the clinic on October 12 revealed the openings to be patent still, and the previous symptoms were absent except for a slight accumulation of mucous secretion in the floor of the nose. The patient was seen again July 28, 1944, and on examination it was felt that although the openings were still patent (fig. 2), it would be advantageous to create one large posterior space communicating with the nasopharynx. The second stage of the operation was then performed, with the patient under local anesthesia. By means of a Gigli saw inserted through the choanal openings, the osseous bridge was removed. The postoperative course was normal. Examination Aug. 28, 1944 with a nasopharyngoscope and a postnasal mirror revealed an adequate bilateral choanal aperture.

RANULA

GEORGE R. LAUB, M.D., COLUMBIA, S. C.

In the medical literature the term "ranula" is not used for one certain condition. All the different cystic tumors of the floor of the mouth are called ranula. Swelling of the submaxillary gland, swelling of the salivary ducts, retention due to stones, dermoid cyst, bursa between the muscles, all these conditions of different origins are summed up under this one term.[1]

Connelly[2] gives a good description of the type of tumor which is termed ranula today.

Clinically, ranula is recognized as a cyst in the sublingual area, benign in character, soft and fluctuating, painless, blue to violet in color, usually unilateral and unilocular but maybe multilocular, and takes on burrowing qualities. It lies above the mylohyoid muscle and produces a swelling in the mouth but may extend around the posterior border of the muscle and produce a swelling in the submaxillary region of the neck. Its wall is extremely thin and the contents consist of a clear, viscid fluid resembling the white of an egg.

The pathologist[3] classes ranula as an adenoma deriving from the sublingual ducts, especially Nuhn's glands (also known as Blandin's glands).

There is not only some confusion in terminology with respect to ranula; the etiologic nature as described in the foregoing paragraphs is not quite clear. Various kinds of treatment are recommended for this condition. Carabba[4] advocated aspiration of the contents and injection of a sclerosing fluid containing phenol, sodium borate and salicylic acid in glycerin. Kleinschmidt[5] expressed the belief that an incision or a puncture never suffices. He recommended radical extirpation of such cysts. Turner[6] reported a case in which he had good results on making an incision and then scraping the cyst with a sharp spoon. Afterward he used a packing of gauze ribbon steeped in a solution of iodine and removed the ribbon after a few minutes. Warbasse[1] extirpates the cyst through the skin of the neck and at the same time makes a new opening through the mucous membrane of the mouth if the salivary gl still functions. He also sutures the gland end of the duct into the new opening of mucous membrane.

Ranulas are small cysts. Those which re large size are rare. Kini[7] reports a large without giving the dimensions of his patholo specimen. According to the photographs in paper, the ranula must have been about the of an orange. An unusually large ranula recently observed by me.

REPORT OF A CASE

G. P. S., a 21 year old Negro woman, was admitte the South Carolina State Hospital because of a me condition. She has psychosis with convulsive disor

Fig. 1.—Ranula before operation.

(epilepsy) and epileptic deterioration. She has been inmate of this hospital several times, the first time 1938. Her family history and her own history c tribute nothing relating to ranula. The physical fi ings in 1940 were entirely normal, and her mouth not show any changes at that time. In July 1944 patient was sent to me because of inability to shut mouth and difficulties in swallowing and in speak According to the patient's statements, which are very reliable owing to her mental condition, the sw ing developed in her mouth slowly during the previ three years.

Physical Findings.—This woman had a cystic tu of the floor of her mouth about the size of a h egg. It was located to the right of the frenulum, under the tongue (fig. 1). She also had a slight sw

1. (*a*) Bailey, H.: Practitioner **132**:651 (June) 1934. (*b*) Fitzwilliams, D. C. L.: Brit. J. Surg. **14**: 472 (Jan.) 1927. (*c*) Singleton, D. L.: Dental Cosmos **70**:985 (Oct.) 1928. (*d*) Warbasse, J. P.: Tumor of the Tongue, in Warbasse, J. P., and Smyth, C. M., Jr.: Surgical Treatment, Philadelphia, W. B. Saunders Company, 1923, vol. 2, p. 291.

2. Connelly, E. J.: J. Iowa M. Soc. **32**:127 (March) 1942.

3. MacCallum, W. G.: Textbook of Pathology, ed. 2, Philadelphia, W. B. Saunders Company, 1922.

4. Carabba, V.: Ann. Surg. **99**:668 (April) 1934.

5. Kleinschmidt: Deutsche med. Wchnschr. **57**:1549 (Sept.) 1931.

6. Turner, A. H.: Brit. M. J. **2**:182 (Aug. 2) 1930.

7. Kini, M. G.: Brit. J. Surg. **26**:947 (April) 1

under the mandible, almost directly below the ne tooth. The salivary ducts were apparently not olved. The blood pressure was 130 systolic and 100 stolic; the heart and the lungs were normal; the assermann reaction was negative; the blood count the urine were normal.

peration (July 25, 1944).—Preoperatively the pa- t received ⅙ grain (0.011 Gm.) of morphine sulfate rounding tissue. It was not hard to separate it from all sides; however, the base offered considerable difficulties. The tumor appeared to be pear shaped, and the lower end went down the neck toward the hyoid bone and the thyroid cartilage. By pressing the base of the mouth upward from the outside it was finally possible to remove the tumor in toto. Since there was little hemorrhage, the wound was spread with sulfa-

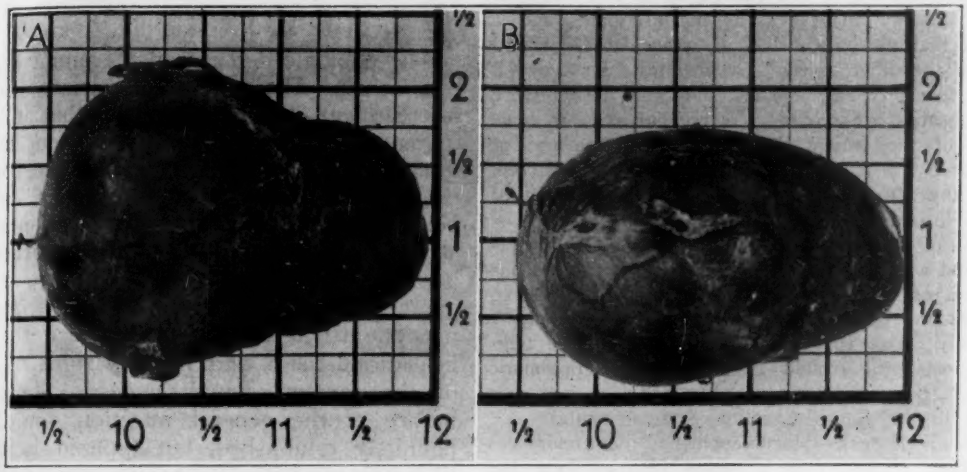

Fig. 2.—*A*, frontal view of the tumor. *B*, side view.

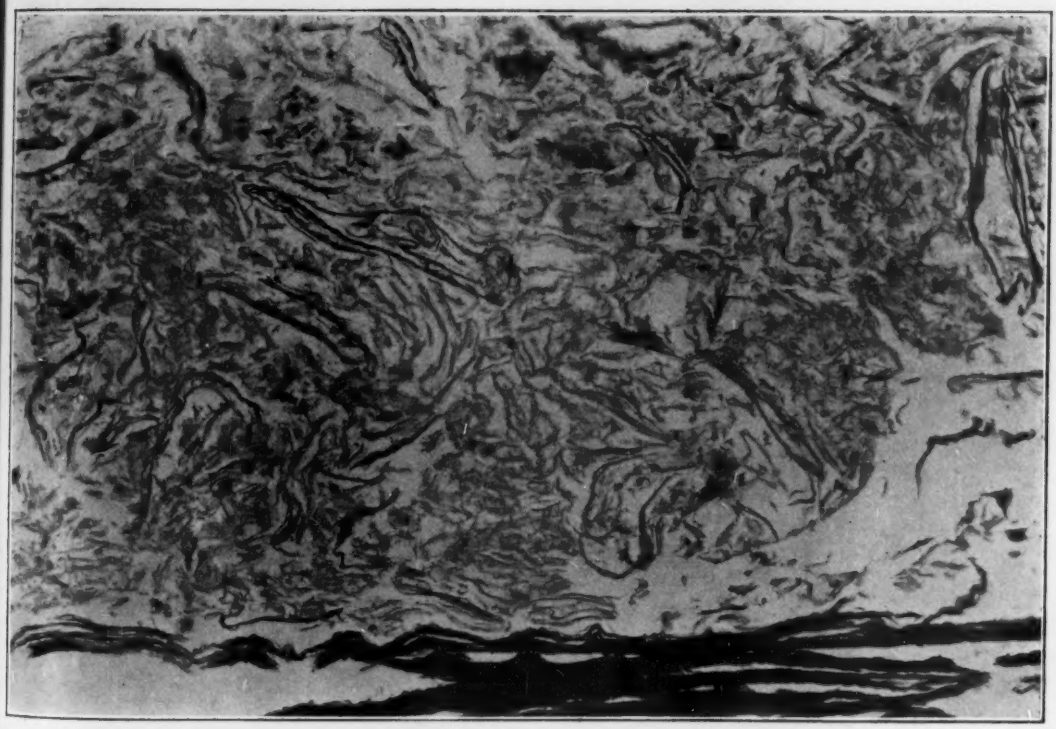

Fig. 3.—Photomicrograph of the tumor, made by the United States Army Medical Museum (negative no. 82210).

d 1/150 grain (0.43 mg.) of atropine sulfate. Topical esthesia was induced with a 2 per cent solution of racaine hydrochloride and block anesthesia of the in- ior alveolar nerve at the lingula with a 1 per. cent ution of procaine hydrochloride. An incision about inches (4 cm.) in length was made at the top of tumor just through the mucous membrane. After- rd the tumor was dissected blandly from the sur- thiazole powder and closed with chromic catgut 00. The anesthesia proved to be sufficient.

Postoperative Course.—Immediately after the operation the temperature was 103 F. It increased on the next day to 105 F. and remained at this level from July 26 until August 5, when it started to drop lytically and continued until, on August 15, it became normal. On the first day after the operation, the sutures were

removed, the wound was powdered with sulfathiazole, and an iodoform gauze drain was introduced. Although no abscess formation could be seen, the patient was given sulfathiazole at the rate of 4 Gm. daily without any effect on the temperature. It was interesting that the white blood cell count before the administration of sulfathiazole was 7,850 with 70 per cent neutrophilic cells and 30 per cent lymphocytes. The pulse rate never went beyond 98 but stayed as a rule between 86 and 92. For these reasons my associates and I suspected that the patient had, by coincidence, typhoid or one of the other fevers. Several tests for typhoid, undulant fever, typhus, malaria and other fevers were always negative. Since the blood count and the temperature of the patient did not change, the use of sulfathiazole was stopped and sulfadiazine administered, without any effect, after which the administration of sulfonamide compounds was discontinued.

In spite of the high fever, the recovery of the operative wound was normal, and the incision in the mucous membrane of the mouth was completely healed ten days after the operation, after having backed out the drain daily for a small amount. However, the temperature was still around 105 F. With symptomatic treatment the patient recovered completely and was returned to the South Carolina State Hospital.

Pathologic Report.—Macroscopically, the tumor was pear shaped, slightly over 2 inches (5 cm.) long and 1⅞ inches wide (5.4 cm.) at its largest diameters (fig. 2). The surface was smooth; the consistency, that of a cyst. The specimen was sent to the U States Army Medical Museum, Washington, D. which furnished the accompanying report of the mi scopic examination and the photomicrograph (fig. "The section is composed of a thin layer of strat squamous epithelium which shows marked evidenc parakeratosis and hyperkeratosis. Subadjacent to is a mass of keratin flakes. The diagnosis is ranul

CONCLUSION

The etiologic description of ranula is not established. There is a great variety of meth of treatment. It is my opinion that it is be to remove the entire cyst than to cut into it inject anything into it. If possible, operat through the mucous membrane is prefer because it does not leave any scars on the s With sulfathiazole locally applied, infection be avoided. The high temperature after operation in the reported case was appare not due to a local infection since the wo healed and there were not any signs of swell of the regional lymph nodes. The etiol nature of the general infection could not definitely established, but typhoid is the m likely diagnosis.

1515 Bull Street.

Clinical Notes; New Instruments and Technics

A NEW INSTRUMENT FOR CLEANING RHINOPLASTIC SAWS

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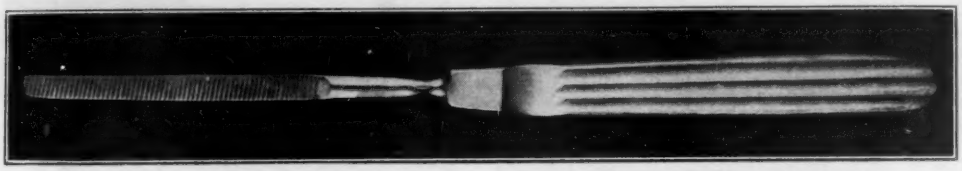
Associate Plastic Surgeon, Harlem Hospital

The instrument illustrated in the accompanying figure is a new instrument devised for the purpose of removing bony debris from the Joseph saws employed in corrective rhinoplasty. This instrument is a three-sided file that is triangular shaped to fit into the interstices of the saw teeth.



Author's file to cleanse the Joseph rhinoplastic saws of bony debris.

Wire or bristle brushes will not remove bony debris that is wedged deep between the saw teeth, whereas the file instrument will do so. The file is drawn between the saw teeth diagonally until the saw is completely clean. The file is sterilized and the saws checked at operation before using them.

There is considerable evidence to indicate that the transfer of bony debris from one patient to another may be attended by a postoperative foreign body reaction that is almost indistinguishable from an infection.[1] I have noted a distinct drop in the number of such postoperative complications since I have avoided this transfer of foreign bony debris by cleansing the saws with the file.

44 East Sixty-Seventh Street.

From the Surgical Service, Harlem Hospital; Louis Wright, M.D., director.

1. Tamerin, J.: Postoperative Infections Following Corrective Rhinoplasty, to be published.

TWIN LOUPE LARYNGEAL MAGNIFIER

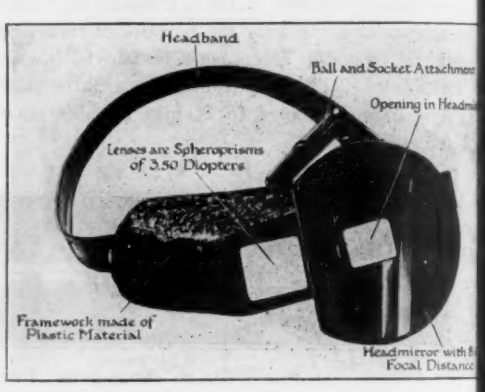
CHARLES J. IMPERATORI, M.D., NEW YORK

The examination of the larynx, particularly the surface structure of the mucosa, the contour of the vocal cords and the arytenoids and their movements, is materially helped by magnification and by stereoscopic vision. This may be accomplished by the use of a binocular loupe, which is an optical device designed to give a magnified image plus the discrimination made possible by the depth perception in stereoscopic vision.

This device consists of a twin loupe with lenses that are spheroprisms of 3.50 diopters, having a working distance of 13 inches (33 cm.). The magnification is about one and three-quarter times. The framework is made of plastic material and is comparatively light. Screwed to the framework is a ball that articulates with a socket extension, which in turn articulates with a reflecting mirror having a focal distance of about 8 inches (20 cm.). This mirror has an opening of sufficient size, approximately ⅞ by ¾ inches (20 by 17 mm.), so that the operator's eye behind it will not have any obstruction in vision due to the mirror. The inner edge of the mirror is cut away so that it will not interfere with the vision of the right eye.

Most laryngologists have the source of light on their left and place the reflecting mirror over the left eye. For those using the right side for the source of light, this device may be modified accordingly.

The use of this device may be described as follows: The headband is adjusted so that the loupe rests comfortably on the forehead. Should the operator be ametropic (imperfect vision for distance), he should wear his corrected lenses. It is inadvisable to wear reading glasses with this device. The mouth of the patient being open, the reflecting mirror is adjust the light source so that the beam of light is br to a focus on the posterior pharyngeal wall. operator keeps both eyes open and should have a view of the entire field. Holding the patient's t as for indirect laryngoscopy, he introduces int oropharynx a properly heated laryngeal mirror directs the light on the mirror. The larynx may


Headband
Ball and Socket Attachmen
Opening in Headm
Lenses are Spheroprisms of 3.50 Diopters
Framework made of Plastic Material
Headmirror with 8 Focal Distance

Twin loupe laryngeal magnifier.

be seen. A sharply magnified image is then ob as the operator moves toward the patient approxi 1 or 2 inches (5 cm.). A little practice will de the stereoscopic vision. The instrument may al used as a magnifier for examination of the nos the ear with one eye.

The use of this device is intended to supple regular mirror examination.

108 East Thirty-Eighth Street.

This instrument is not as yet in production. The working model was constructed for the author by Mr. George Swikart, Plastic Sales Corporation, 140 West Seventy-Second Street, New York 23, N. Y.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

ALLERGY

ERNEST L. MacQUIDDY, M.D.
OMAHA

llergy was one of the many problems en-tered by the Army when recruiting the man-er necessary for this war. Hyde and Kings-report on the findings in 60,000 men, the 6,000 of whom were from 21 to 34 years ge and the remainder from 21 to 44 years. these men came from a limited section of sachusetts. The examinations were made team of civilian internists. Of the men mined, 495 were disqualified because of severe gic states. The rejection rate was high in semirural areas, lowest in the one family dential districts and high again in the crowded ments.

lank[2] records that over 1 per cent of all ers entering the Armed Forces require care this condition. There is need of a special on in the Army Medical Corps for control llergic conditions, and specific physical stand-should be set up for recruits with major gic diseases. He suggests that the Army gist's duty not only should include the diag-s and prognosis of allergy, but should include k with ophthalmologic, otorhinolaryngologic dermatologic sections of the Medical Corps, also supervision of vaccine therapy. An esting table gives the statistics of the allergy of the station hospital in Fort Eustis, Va., June 1, 1941 to Oct. 1, 1942. The number llergic patients seen was 1,833. There were with respiratory allergy divided as follows: fever, 417; asthma, 289; perennial rhinitis, allergic sinusitis, 28; nasal polyps, 24; der-ologic allergies, 773; ophthalmologic allergies, conjunctivitis, 104; ulcerative keratitis, 26; rointestinal allergies, 5; allergic migraine, 6. reporting on patients with ophthalmologic lvements the author states that only those ophthalmologic allergies were included. If conjunctivitis might be associated with hay r, the case was listed under the heading hay r.

French and Halpin[3] give a report on their experiences in allergy clinics in the Fourth Service Command. In March 1942 an allergy section of the Surgeon's Office, Fourth Corps Area, was established. It was the purpose of this section to establish and maintain a clinic at each station hospital in the Fourth Service Command; prepare, standardize and issue extracts of allergens; supervise clinical investigation and therapy of allergic diseases; render opinions on physical examinations of officers or officer candidates with allergic histories or findings, and cooordinate and submit reports on allergic diseases in the command.

A report of the allergy clinic of the Fourth Service Command was made to the Office of the Surgeon General. The material in the report was gained from twenty-one clinics in operation from April to October 1942. While there were more clinics than this established in the Fourth Service Command, only those established the entire period were considered. The report shows a total of 3,917 patients treated; 3,419 were military personnel, and 498 were civilians. This report lists 633 cases of pollen hay fever, 283 cases of pollen asthma, 759 cases of perennial bronchial asthma, 192 cases of combined hay fever and bronchial asthma and 770 of perennial allergic rhinitis. The report also shows that 1,153 patients with allergy were admitted to the hospitals and that the average number of hospital days was 18.1. There were 195 allergic patients discharged with a certificate of disability, compared with 267 who were successfully reclassified and maintained on limited service.

Young, Cook and Kawasaki[4] discuss allergic rhinitis and asthma as observed among soldiers in Hawaii. They treated 114 patients for exogenous asthma, 51 for endogenous asthma and 57 for allergic rhinitis. The perennial type of pollination found on the island produces perennial

Hyde, R. W., and Kingsley, L. V.: Distribution llergic States in Selectees, J. Allergy **14**:386-392) 1943.

Blank, P.: Military Aspects of Allergy, J. Lab. in. Med. **28**:609-618 (Feb.) 1943.

3. French, S. W., and Halpin, L. J.: Army Allergy: Report on Allergy Clinics in Fourth Service Command, Ann. Allergy **1**:1-16 (July-Aug.) 1943.

4. Young, C. T.; Cook, W. R., and Kawasaki, I. A.: Allergic Rhinitis and Asthma in Hawaii, War Med. **3**:282-290 (March) 1943.

allergic rhinitis and exogenous asthma, and the symptoms are more severe and prolonged than those of patients on the mainland. Many persons with asthma, especially those with the endogenous type, had experienced no symptoms on the mainland. The high humidity and the low altitude of the islands are contributing factors in producing the high incidence of endogenous asthma. The dust in Hawaii contains pollens of native grasses, weeds and trees and was found to be the most common excitant inhalant allergen. Of the 222 patients listed, 97 gave a history of no previous allergic disorders, and 100 gave no familial history of any allergic condition.

Criep [5] describes the allergy clinic organized in 1936 at the Veterans' Administration Facility, Pittsburgh. He states that the opportunities for complete study of allergic problems are unusually good; practically all allergic patients are hospitalized for diagnostic purposes, which allows a period of close observation under controlled environmental and dietary conditions. All allergic conditions are studied and the methods of study and the treatments are outlined.

NASAL ALLERGY

Shambaugh,[6] in discussing nasal allergy, states that an allergic factor is present in the majority of cases of chronic nasal and sinus infection. If this factor can be found and removed, the infection tends to clear spontaneously, with little tendency to recur. If the allergic factor is overlooked, the infection has a tendency to persist or to recur in spite of prolonged local treatment and repeated surgical procedures. He recommends that the rhinologist become his own allergist, because the allergy and the infection should be treated simultaneously. Cutaneous tests and nasal smears must be regarded as aids but not the means of a diagnosis of allergy. The diagnosis should be based on the therapeutic test. The cutaneous tests aid in diagnosing inhalant allergies but are of little value in diagnosing food allergies. With the latter, elimination diets are usually required. House dust is the most frequent single cause of chronic nasal and sinus disease. He divides chronic sinusitis into two groups: pure infection 30 per cent and allergic chronic sinusitis 70 per cent. He gives a good table showing the differentiation between these two types. Describing chronic allergic sinusitis, he states that there may be an infection with staphylococci or streptococci secondary to chronic edema. There is usually an insid onset. The ethmoid sinuses are the ones frequently involved. The changes are fo in both the nasal mucosa and the mucos the sinuses and are edema, development of po and excessive secretion. Symptoms usually p ent are nasal blocking, sneezing, coughing, m purulent nasal and postnasal discharge, freq headaches, fatigue, lassitude and sometimes trointestinal symptoms. The sinal mucosa sh desquamating epithelium with an increased n ber of goblet cells, thickening of the base membrane, edema of subepithelial connective sue, which is infiltrated by eosinophils in a tion to plasma cells and polymorphonu leukocytes. Stained slides of the pus will s from few to many eosinophils mixed with neutrophils.

Cooke [7] discusses the treatment of patients hay fever and asthma, and in commenting hyperplastic rhinitis he states that with this dition one must also consider sinusitis and po osis, for they are frequently associated. I versible tissue changes have taken place. many cases the rhinitis is associated with v motor reactions to air-borne excitants. It se to follow long-standing vasomotor allergies may be caused by the latter. He consider as a special sensitization reaction to bacte invasion, which is the primary cause, aided abetted by the existing vasomotor change.

Infection dominates the clinical picture mately. Treatment consists of managemen contributing factors, specific vaccine therapy symptomatic drug therapy. He states tha yet there is no satisfactory evidence that e endocrine dyscrasias or vitamin deficiencies c or predispose to the condition. Food aller in his experience are rare; air-borne factors common. The search for the causative or ism is difficult as his work has shown tha at least 50 per cent of the cases the organi found deep in the tissues are not identical v those obtained from the surface swabs or f irrigation returns. Without operation, howe cultures of surface material are the best a able for vaccines. The author believes in gical treatment for sinusitis because he has its benefit in many persistent and other intractable conditions. He states that rarel surgical intervention indicated in a patient un 25 years of age. If the patient has been pro

5. Criep, L. H.: Practice of Allergy in Veterans' Administration, M. Bull. Vet. Admin. **19**:414-418 (April) 1943.

6. Shambaugh, G. E., Jr.: Nasal Allergy, J. Michigan M. Soc. **42**:441-445 (June) 1943.

7. Cooke, R. A., in Conferences on Therapy: T ment of Asthma and Hay Fever, New York Sta Med. **43**:1224-1232 (July 1) 1943.

sitive to foods or to inhalants, avoidance of, treatment with, the allergen should be prac- d before and after the surgical procedure. e object of opening a sinus surgically is to ove infected tissues, to leave the sinus well n for drainage and to conserve as much tissue the turbinal bones as possible. The patients surgical treatment should be carefully selected the basis of their physical condition, and should not expect satisfactory results in ents who have old long-standing allergies extensive pulmonary fibrosis. In discussing treatment of infective asthma he says that ething can and should be done about areas focal infection. He advocates early removal infected tonsils and adenoids. Primary foci found in 85 per cent of his patients with ctive asthma. The teeth are important so as they may be the origin of sinus infection. uses, and particularly the antrums, are the t frequent foci of infection found.

According to Bray,[8] the allergic nose is pre- ted first to the rhinologist, and the treatment it forms at least one third of his practice. ergy should be suspected always in patients eriencing nasal itching, sneezing, running, ckage, anosmia and polyposis, especially if re is a family history of allergy. The nasal ptoms are an exaggeration of normal physio- c actions, the first of which is the warming moistening of inspired air. He states that mally the tissues on the turbinal bones of side are filling while those on the turbinal es of the other side are throwing off secre- —a cycle occurring each two and one-half rs. In the allergic nose the warming and stening function is exaggerated on the least nulation by cold air, and where the particles which the patient is sensitive lodge, in the ring of the air, localized urticaria appears. ides the nasal symptoms which develop, there also be cough from the mucoid postnasal or from the resultant mouth breathing of unfiltered air conveying particles to the rynx and later to the lungs, to cause asthma. ong the known specific irritants producing l allergy he includes strong smells, bright ts, tobacco smoke, petrol or oil fumes, sulfur es from stoves and chlorine in pools or water. states that conservatism should be the key- e of surgical treatment.

Polson [9] gives a brief history of contributions he knowledge of nasal allergy, beginning with Bostock's in 1819. He deals with the biochemical aspects of nasal allergy and surmises, from the work presented, that there is a tendency toward a deficiency of hydrochloric acid in the gastric juice of allergic patients. He thinks that there is a lowering of the blood sugar content in persons with allergies. Liver function, he says, is altered little if any. He lists the abnormalities observed with the naked eye in a series of 140 nasal structures seen at postmortem examinations: sinus empyema in 16, edema of sinal mucosa in 7, sinus edema with empyema in 10, nasal mucous polyps in 6, sinal mucous polyps in 16, septal deflections (severe) in 12, hyperplasia of tissue on the inferior turbinate bones in 3 and osteoma of the ethmoid sinus in 1. In describing nasal allergy from the standpoint of histopathology he states that the outstanding changes are eosinophil infiltration and edema of the tunica propria. He also discusses eosinophilia of the tissues and states that in the absence of blood eosinophils he has difficulty in accepting the bone marrow as the sole source of eosinophil leukocytes.

Salinger,[10] in his review of the literature on the paranasal sinuses, quotes various authors as to the causes and the treatment of allergic disorders of the sinuses.

VASOMOTOR RHINITIS

Gelfand [11] reports 52 cases of representative perennial rhinitis and states that in 46 of the cases the rhinitis was of allergic origin. Multiple sensitivities were present in the vast majority. With but few exceptions, rhinitis was the sole clinical manifestation. Hay fever, asthma and urticaria occurred with the perennial rhinitis in a few cases. Inhalant allergens were most often responsible for the rhinitis, but he could demonstrate food sensitivity in 11 cases. He lists a number of occupations in which irritants are to be found which may be causative factors in vasomotor rhinitis. Successful treatment of the patient with this type of disease depends on a complete history, including the patient's own description of his home and occupational environment. Wherever possible a study should be made of both the home and the working conditions of the patient. His intake of food should be studied by means of a food diary. Cutaneous tests should be made with all materials to which the patient might be allergic.

8. Bray, G.: Nasal Allergy (Excluding Hay Fever), Laryng. & Otol. **58**:219-223 (June) 1943.

9. Polson, C.: Nasal Allergy (Excluding Hay Fever), J. Laryng. & Otol. **58**:224-237 (June) 1943.

10. Salinger, S.: Paranasal Sinuses: Review of Literature for 1942, Arch. Otolaryng. **38**:373-396 (Oct.) 1943.

11. Gelfand, H. H.: Allergic Aspect of Vasomotor Rhinitis, Arch. Otolaryng. **37**:1-14 (Jan.) 1943.

King and King [12] think that there is an overuse of astringent solutions or vapors on the part of patients with allergic noses. In their experience these remedies are harmful to some patients. In spite of all measures adopted by both the allergist and the rhinologist, there are patients whose allergic conditions are refractory to treatment. Nine had come under their observation. The nine were sent the following question: Are the symptoms the same? Is there any improvement? What have you tried since last seen? Have you any cough or asthma? Have you found the cause of your symptoms? Five answered the questionnaire. One noted improvement after moving to another locality; one experienced improvement without any treatment; one said that improvement became noticeable with nasal treatment and injections of some iodine preparation; one reported improvement after complete removal of polyps and sinal mucosa, and the fifth, after using acetylsalicylic acid and mistol drops (mistol is liquid petrolatum containing camphor, eucalyptol, menthol esters and chlorobutanol).

Mohum [13] writes on the presence of vasomotor rhinitis during pregnancy and presents a series of 20 cases. He devotes a good deal of the article to the construction of as reasonable a background as possible for the facts that he has encountered. He states that a complete reconcilement is not possible. He discusses the relation of atrophic rhinitis to minimum production of estrogen. In his clinical experience when the estrogen level is high there is a definite tendency toward hyperemia and swelling of the mucous membrane. His conclusions are that vasomotor rhinitis and associated conditions occur with definite frequency during pregnancy. In his series of 20 cases there were 8 in which a severe degree of nasal blocking occurred during pregnancy although in the nonpregnant state there was never any trouble of this nature. In 12 other cases severe nasal blockage occurred during pregnancy but in these there was a history of previous transient attacks of hay fever and nasal blocking in the nonpregnant state. In 9 pregnant women with purulent sinusitis the infection was more protracted and the mucous membrane more swollen than is usually encountered. These women showed no response to the usual therapy, but in all the condition qui cleared after delivery. From a theoretic clinical standpoint allergy did not seem to the predominant etiologic factor. The au concludes that the vasomotor rhinitis occur during pregnancy appears to parallel and caused by the accumulation of estrogen in body.

Hansen-Pruss and Raymond [14] used ser from allergic women for passive transfer te The serums were collected in the midperio the menstrual cycle, four days before catame on the first and the last day of menstruat and four days after cessation of the menses. tests were made through at least one comp cycle. Passive transfers were made to 5 hea male medical students proved to be nonaller All the women whose serums were used w clinically sensitive to short ragweed and g a strong positive cutaneous reaction to the s ragweed allergen. This was used as the substance. The largest positive reactions w obtained in sites sensitized with serums obtai on the last day of menstruation. The smal reactions were seen in areas which had b prepared with serums obtained ten days be the onset of menstruation. It is concluded t the serum of an allergic woman contains allergen in highest concentration on the last of menstruation—a period which marks the phase of estrogenic deprivation. It is theref suggested that the titer of the allergen in serum of the allergic woman is in inverse p portion to the estrogenic level.

Fowler [15] presents the case of a woman w unilateral vasomotor rhinitis due to interfere with the cervical sympathetic system. In Feb ary 1939 a small lump which had been on left wrist for twenty years and which had b diagnosed as a cyst was removed. The tu proved to be a neurofibroma of the median ne Removal was followed by causalgia of the me nerve. Neurolysis was performed but gave relief. Injections of alcohol afforded only t porary relief. A secondary tumor developed the old site. Because of severe pain, the stellate ganglion was removed in August 19 Following this, there was no relief of pain the wrist. There were drooping of the left ey and constriction of the pupil, pain in the eye and stuffiness in the left nostril. With

12. King, E., and King, J. H.: Symptomatic and Empiric Treatment of Allergic Nose: Follow-Up Questionnaire in Cases in Which Rhinitis Was Refractory to Treatment, Arch. Otolaryng. **37**:645-649 (May) 1943.

13. Mohun, M.: Incidence of Vasomotor Rhinitis During Pregnancy, Arch. Otolaryng. **37**:699-709 (May) 1943.

14. Hansen-Pruss, O. C., and Raymond, R.: In ence of Menstrual Cycle on Titer of Circulating A gins, J. Clin. Endocrinol. **3**:81-84 (Feb.) 1943.

15. Fowler, E. P., Jr.: Unilateral Vasomotor R itis Due to Interference with Cervical Sympat System, Arch. Otolaryng. **37**:710-712 (May) 194

inning of cold weather, in September 1940, e appeared sneezing spells lasting thirty utes. The left side of the nose became con- tly stopped, and the watery secretion from as so uncontrollable that it interfered with work. The patient was relieved by the oral of syntropan. She is still relieved of most her symptoms but has some trouble with den changes in air temperature. After re- ing this case the author examined the noses 4 other patients with Horner's syndrome. e patient was relieved after a submucous resec- . In the other 3 there was no involvement he nasal mucosa.

HISTAMINE

Girling [16] reports on the administration of his- ine phosphate as a method of managing gic conditions. He experimented with pa- ts taken at random in his practice. The ority of these patients had been proved to er from allergy; many had responded tem- arily to the use of potassium chloride, and ers had shown eosinophilia. His report covers ults in 120 patients divided as follows:

	Patients
1. Postnasal drip with other evidences of allergy, such as intermittent nasal obstruction	73
2. Nasal allergy with conductive deafness	14
3. Lower half headache	20
4. Asthma	6
5. Allergic dermatitis	5
6. Laryngitis	2

describes the administration of histamine sphate, stating that the number of doses ed from 25 to 40. The results were ex- ely gratifying. Of 73 patients treated for al allergy 70 received complete relief. Two slight relief, and 1 was unrelieved. The bers obtaining complete relief in the other ptomatic groups were as follows: lower half dache, 15 of 20; conductive deafness, 5 of 14; ma, 5 of 6; dermatitis, 4 of 5; laryngitis, 2. The author concludes that it appears the use of histamine phosphate to cure gic states is of definite value but that it is early yet to speculate as to the permanency he cure.

Gant, Savignac and Hochwald [17] report on oral use of histamine phosphate in a series of 30 cases. The original series started with 46 cases but 13 were lost and the end results were unknown. In 3 cases treatment had to be discontinued because of lack of cooperation on the part of the patient. In 1 of the remaining 30 cases no effect occurred with doses up to 15 drops of a 1 to 100 solution, and in another case there was temporary relief with 5 drops of a 1 to 1,000 solution, but the patient's condition became refractory, and though the dose was increased, no relief was obtained. In the other 28 cases histamine phosphate produced repeatedly, or regularly, an immediate beneficial effect. Most of the patients were followed over a period of several months. The authors state that the most striking effects were seen in those with vasomotor rhinitis. The symptoms ceased within ten to twenty minutes after a dose of histamine phosphate had been taken by mouth, and relief usually lasted for several hours. The authors state that certain unpleasant by-effects cannot be avoided. Gastric cramps may appear, or menstruation may be strongly affected. They conclude that histamine phosphate is not a panacea and that much remains to be done but that the results of its oral use are definitely superior to those obtained with other methods of treatment.

Browne [18] studied cutaneous reactions as an index to histamine desensitization and concluded that if histamine flares are to be evaluated correctly they must be produced under carefully controlled conditions. These consist of constant temperature, constant environment, standard posture of the arm and of the subject, standard source of light and uniformity of technic. His final conclusion was that histamine flares provoked at intervals of approximately two weeks in subjects treated with gradually increasing amounts of histamine phosphate, administered subcutaneously twice daily for the same period, disappear in 40 per cent, are significantly reduced in 25 per cent and insignificantly changed in 35 per cent. There is an apparent correlation between the clinical result of treatment and the state of the histamine flare. Assuming the skin to be an index of systemic desensitization, he says that 40 per cent of the patients showed complete and 25 partial desensitization and 35 none. The desensitization phenomenon is probably accompanied by much individual variation and is perhaps relatively short lived.

Girling, W. N. M.: Administration of Histamine Allergic Conditions, Northwest Med. **42**:196-197 y) 1943.

Gant, J. C.; Savignac, R. J., and Hochwald, A.: amine by Mouth in Treatment of Vasomotor Rhin- New England J. Med. **229**:579-582 (Oct. 7) 1943.

18. Browne, H. C.: Cutaneous Reactions as Index to Desensitization to Histamine, J. Allergy **14**:19-48 (Nov.) 1942.

Fell, Rodney and Marshall [19] have done an interesting piece of work in attempting to discover whether artificial immunity to histamine could be developed in animals and man so that any excess of histamine released by an antigen-antibody reaction would be bound by specific antibodies before it could reach the shock organs and produce the typical symptoms of anaphylaxis or allergy. They prepared histamine-protein complexes (the chief of which was despeciated normal horse serum globulin linked to p-aminobenzoyl histamine after diazotization of the latter), and with these preparations studied the problem chiefly in rabbits. Their conclusions were that hyperimmunization of animals with the preparations they used produced antibodies that were partially specific for the histamine hapten. The immunized animals displayed a marked degree of resistance to anaphylaxis.

Rodney and Fell [20] continued the work. They prepared an antigen by coupling the isocyanate derivative of histamine (prepared by the action of phosgene on histamine in a chloroform solution) with despeciated horse serum globulin. They carried out studies with regard to the immunologic properties of the complex and its ability to protect against anaphylaxis. Protection against symptoms of anaphylaxis in guinea pigs after immunization with the complex was demonstrated by both in vivo and in vitro experiments.

NEWER PREPARATIONS USED IN ALLERGY

Friedman and Cohen [21] reported on the use of nethamine hydrochloride (a tertiary amine known chemically as levo-1-phenyl-2-methyl-ethylamine 1-propanol hydrochloride) in the treatment of allergy. The dosage was 0.13 Gm. of nethamine hydrochloride per day. When this preparation was compared with ephedrine sulfate, it was found less toxic than the latter. Forty-eight per cent of the patients with asthma and 61 per cent of those with hay fever were relieved. There were no significant changes in blood pressure or in pulse rate with the doses used. It was their opinion that clinically this new compound seems to be as efficacious as ephedrine sulfate, with fewer side effects.

Hansel [22] reports the use of tablets of nethamine combined with theophylline isobutanolamine in the treatment of allergy. The tablets consisted of ¾ grain (0.048 Gm.) of nethamine hydrochloride and 2 grains (0.13 Gm.) of theophylline isobutanolamine. He observed the effects of the tablets in 250 patients with nasal allergy and bronchial asthma. Fifteen of the patients were children varying in age from 2 to 15 years. The studies were conducted over a period of three years. In addition to the tablet form, 10 cc. ampules containing ¾ grain of nethamine and 3¾ grains (0.238 Gm.) of theophylline isobutanolamine were used for intravenous and intramuscular injections. The 10 cc. ampule was dissolved in 50 to 100 cc. of saline solution or 5 per cent dextrose solution for intravenous injection. Recently he has been using a rectal suppository consisting of nethamine 1½ grains (0.092 Gm.), and theophylline isobutanolamine, 4 grains (0.26 Gm). He concludes after his study that the use of nethamine with theophylline isobutanolamine in the treatment of nasal allergy and asthma has been more satisfactory. In the majority of the cases it gave effective relief. Untoward side effects were inconspicuous. He cautions that the intravenous solution should be injected at a slow rate. If it is given rapidly, sensations of heat and burning, particularly of the face, fulness of the head and chest, headache and occasionlly nausea may occur.

Dees [23] reports on the use of rectal suppositories containing 0.25 Gm. of theophylline ethenediamine. While her report deals with the use of this preparation in the treatment of severe asthma, the drug has been effective and certain will find wider application in the field of allergy.

Formby [24] describes the use of radium paste in the treatment of vasomotor rhinitis. He has used this method in some 30 cases of recurrent polyps. Such a measure, however, certainly is not to be used generally and should be left in the hands of the specialist. Its use is reported in a series of 17 cases, with good results in 11, doubtful results in 6, no report in 4 and failure in 1.

19. Fell, N.; Rodney, G., and Marshall, D. E.: Histamine-Protein Complexes: Synthesis and Immunologic Investigation; Histamine-Azoprotein, J. Immunol. **47**:237-249 (Sept.) 1943.

20. Rodney, G., and Fell, N.: Histamine-Protein Complexes: Synthesis and Immunologic Investigation; β-(5-Imidazolyl) Ethyl Carbamido Protein, J. Immunol. **47**:251-259 (Sept.) 1943.

21. Friedman, A. J., and Cohen, A. E.: Use of New Ephedrine-like Drug in Hay Fever and Asthma, Northwest Med. **42**:138-140 (May) 1943.

22. Hansel, F. K.: Nethamine Hydrochloride Theophylline Isobutanolamine in Treatment of Allergy and Asthma, Ann. Allergy **1**:199-207 (Dec.) 1943.

23. Dees, S. C.: Use of Aminophylline Rectal Suppositories in Treatment of Bronchial Asthma: Preliminary Report, J. Allergy **14**:492-494 (Sept.) 1943.

24. Formby, M. L.: Nasal Allergy (Excluding Hay Fever), J. Laryng. & Otol. **58**:238-242 (June) 1943.

aul [25] describes the treatment of allergy with w duodenal extract. He is enthusiastic about results obtained. He states that the clinical on of the preparation may be augmented by inistering a pilocarpine salt simultaneously. estion of alcohol as a beverage or a medicine nullify the effects of this treatment.

rowning [26] studied cutaneous reactions to acts of various molds to evaluate the different ds as causes of allergy. He used thirty-three acts of individual species and five mixed acts. By statistical analysis he shows that teen of the thirty-eight extracts were irritants of no clinical value. Of the remaining nty-four extracts, only three had a diagnostic iency as high as 70 per cent. Most of the irritant extracts had an efficiency of about per cent. He concludes that the incidence utaneous reactions to extracts of air molds st be studied in relation to the irritant quali- and the diagnostic efficiency of the extracts. emphasizes the importance of using efficient istics for the analysis of biologic data.

ean [27] reports that Spanish moss, a wide- ad native plant in Florida and some of the r southern states, has antigenic properties. reports the case of one who was sensitive to plant.

urham [28] gives Kochia scoparia as a factor nhalant allergy. This is a new active inhalant en found in the middle Mississippi Valley, re ragweed has heretofore been dominant. s weed is becoming much more common year in the area mentioned, and it is an resting conjecture as to whether it will travel her south and east.

ottlieb and Urbach [29] publish an excellent le in which they divide the United States nine zones and give the pollen-bearing plants wing in each zone and the seasons of pollina- . The facts presented are much needed by sicians and will be helpful when patients advised where they may travel to avoid nding pollens. One plant mentioned as grow- in zone 5 but not mentioned as growing in zone 6 grows in the latter zone—Cannabis sativa, the common hemp, which is plentiful throughout a good part of Iowa, Nebraska and Missouri and the northern half of Kansas, pollinating in July and August.

5. Paul, T. M.: Prompt and Permanent Annihilation of Sensitiveness to All Allergens, Urol. & Cutan. **47**:36-41 (Jan.) 1943.

6. Browning, W. H.: Mold Fungi in Etiology of piratory Allergic Diseases: Mold Extracts—Statistical Study, J. Allergy **14**:231-243 (March) 1943.

7. Dean, G. A.: Allergic Rhinitis Due to Spanish s, J. Allergy **14**:340-342 (May) 1943.

8. Durham, O. C.: Kochia Scoparia as Factor in alant Allergy, J. Allergy **14**:160-170 (Jan.) 1943.

9. Gottlieb, P. M., and Urbach, E.: Distribution Pollination Times of Important Hay Fever–Producing Plants in United States, J. Lab. & Clin. Med. 1053-1070 (June) 1943.

ALLERGY IN CHILDHOOD

Criep [30] gives a short account of the various allergies occurring in childhood. He states that allergic rhinitis is not uncommon in children, that it is perennial and is frequently mistaken for colds and that the nasal secretions are thin, watery and rich in eosinophils. He states that it is conservatively estimated that at least 10 per cent of infants and children are at one time or another in need of allergic treatment. The onset of allergy may occur at any age. He states one interesting fact that needs emphasis—that, contrary to the belief of some, children do not outgrow their allergies. In some instances there may be a spontaneous remission. In other instances a child may become symptom free because of an accidental change in environment. As a rule, in spite of wishful thinking and endless temporizing, the allergic child continues to suffer if not treated.

Peshkin and co-workers [31] discuss the use of histaminase in the treatment of allergy in children. Their study comprised 48 allergic children. These children, some of whom had two or more allergic syndromes, were treated by being given a daily dose of 50 units of histaminase in enterically coated tablets. Each tablet contained 5 units of the dry powder derived from the mucosa of the small intestine and the kidney of the hog. Treatment was maintained for periods of two to twenty weeks, or an average of nine weeks per patient. The writers conclude that histaminase proved ineffective as a prophylactic, phylactic or adjunctive therapeutic agent in all the children treated.

MIGRAINE AND MÉNIÈRE'S SYNDROME

Pfeiffer and associates,[32] studying the blood volume of patients with migraine headache, present data which in their opinion justify separating from the so-called common headache two new types, namely: headache due to relaxation

30. Criep, L. H.: Importance of Allergy in Practice of Pediatrics, Pennsylvania M. J. **46**:816-821 (May) 1943.

31. Peshkin, M. M., and others: Histaminase in Treatment of Allergy in Children, J. Pediat. **22**:426-431 (April) 1943.

32. Pfeiffer, C.; Dreisbach, R. H.; Roby, C. C., and Glass, H. G.: Etiology of Migraine Syndrome: Physiologic Approach, J. Lab. & Clin. Med. **28**:1219-1225 (July) 1943.

and headache due to withdrawal of caffeine. The former is accompanied by decreased blood volume, and the latter may be ascribed to a relative increase in the effective arterial blood volume. No consistent blood electrolyte changes occur with relaxation or migraine headache. The determination of the serum proteins and the hematocrit reading during and after migraine headache indicate that the syndrome of migraine is accompanied by real hemoconcentration. Many other known factors in this syndrome can be correlated with changes in blood volume and peripheral vascular tone.

Atkinson [33a] discusses the diagnosis and the treatment of Ménière's syndrome. He emphasizes that accurate diagnosis is essential to efficient treatment. He states that in some cases Ménière's syndrome has an allergic basis. It was his belief that he could determine this type by sensitivity to histamine, using the cutaneous method of testing. In this way he divided the patients who were sensitive to histamine from those who were not. Most of those who were sensitive to histamine he treated by the slow method described in a paper previously published by him.[33b] He cautions against treating the headache of any patient who is insensitive to histamine. He states that of the 49 cases available for analysis, relief was obtained in 20 and improvement in 25 and that failure was recorded in 4 cases.

Atkinson [34] discusses the Ménière syndrome and migraine and concludes that the two groups into which cases of Ménière's syndrome can be divided have been shown to correspond etiologically to two groups of cases of migraine. In many cases of both groups the two conditions are coincidental and apparently related, or the attacks of migraine merge into attacks of the Ménière syndrome. The treatment which has proved successful in relieving the vertigo of patients with Ménière's syndrome has also relieved the migraine headache of those among them in whom such headache was present. He concludes that the treatment of this syndrome, whether characterized in the main by vertigo or by headache, to be successful depends on the accurate grouping of cases. No single method will achieve success in all cases, for there is more than one cause.

33. Atkinson, M.: (*a*) Diagnosis and Treatment of Ménière's Syndrome, Arch. Otolaryng. **37**:40-53 (Jan.) 1943; (*b*) Observations on the Etiology and Treatment of Ménière's Syndrome, J. A. M. A. **116**:1753 (April 19) 1941.

34. Atkinson, M.: Ménière's Syndrome and Migraine: Observations on Common Causal Relationship, Ann. Int. Med. **18**:797-808 (May) 1943.

Feinberg [35] gives a short statement of allergic aspects of headache. He describes of the mechanisms of migraine as allergy gives his reasons for considering an allergic b for the condition. He says that about one of patients with migraine can be shown t allergic, and he knows no satisfactory expl tion for the migraine of the others at the pre time.

ALLERGY OF THE EAR AND EYE

Noun [36] reports 2 cases of otorrhea appare caused by sensitivity to a food. He states such cases are rare. One child made impr ment after being treated for sensitivities to weed and dust. Another was benefited by elimination of eggs, to which the child had proved sensitive.

Kuhn [37] discusses allergy in relation to h ing defects. He has noted that some all children with hearing defects showed def improvement of hearing when placed under a gic management. He also noticed some t of deafness that seemed to be aggravated by a gies and some pathologic conditions that see to have allergy superimposed. He concl that there is an appreciable number of pat with hearing lowered by allergy. Their au grams are changed when epinephrine is g and they themselves are improved by all management. There may be a combinatio a pathologic condition of the ear and a su imposed allergy.

Marton [38] discusses vernal conjunctivitis, ing that in recent times the trend of explan has been toward allergy as a basic factor. presents 4 cases in support of the claim pollen is the prime etiologic factor of this dition. He states that vernal conjunctivit a component part of ocular allergy, that sp treatment with the extracts of the offen pollen will bring quick relief and that the p extracts must be given in high concentr for proper results.

ALLERGY IN MENTAL DISORDERS

Zeller and Edlin [39] studied allergy in pat with mental diseases. They tested 372 psyc

35. Feinberg, S. M.: Allergic Aspects of Hea Arch. Otolaryng. **38**:199 (Aug.) 1943.

36. Noun, L. J.: Chronic Otorrhea Due to Sensitivity, J. Allergy **14**:82-86 (Nov.) 1942.

37. Kuhn, H. A.: Allergy in Hearing Defec Indiana M. A. **36**:143-147 (March) 1943.

38. Marton, S.: Vernal Conjunctivitis (Spri Vernal Catarrh), Ann. Allergy **1**:39-42 (July- 1943.

39. Zeller, M., and Edlin, J. V.: Allergy in I J. Allergy **14**:564-567 (Nov.) 1943.

nts and conclude that the incidence of hay and asthma in patients with psychotic dis—whether organic or inorganic—is the same hat in persons not suffering from mental ses. Mental unbalance does not influence degree of hay fever. There is suggestive nce that forms of allergy other than hay and asthma are not uncommon in psychotic nts.

pangler [40] studied allergic findings in epileptic nts. He states that recognized allergic ptoms may appear in a person afflicted with psy but that whether a convulsion is directly ndirectly indicative of a patient's lack of lopment of an allergic cellular mechanism fense needs immunologic proof. It appears nable to him to assume, however, that in tient who suffers periodic states of uncon- sness with or without convulsive seizures who has a familial background with some itely recognized manifestation of personal rsensitivity there is a possibility of allergy an etiologic factor, which is well worth tigation.

MISCELLANEOUS

x [41] presents a case of disseminated lupus ematosus and raises the question whether may or may not be an allergic disorder. e case described there is presumptive evi- e of a relationship between the parenteral nistration of a foreign protein and the lopment of disseminated lupus erythema- . The possibility is suggested that lupus ematosus may, like periarteritis nodosa, ually prove to be a pattern of hypersensitive ions to a variety of antigens.

ennig [42] studied the reactions of the skin to mine and to natural allergens in patients were under prolonged ether or nitrous oxide oxygen anesthesia or in the state of shock. as his opinion that these three conditions ased the reactivity of the skin to injections stamine and natural allergens.

retz, Harten and Walzer [43] report that it has demonstrated by a direct immunologic tech- hat traces of unaltered protein are rapidly bed from the urinary bladder in the rhesus key and in man. This opens up the possibility of the urinary bladder being a source of entry of antigens in obscure cases of allergy.

Swartz [44] reported 2 cases of sensitivity to tetanus toxoid in atopic persons. The manifestations had been present in 1 patient for more than two years. In the other hyposensitization with tetanus toxoid produced marked symptomatic improvement. The author emphasizes that tetanus toxoid (a fluid), not tetanus toxoid alum precipitated, was used.

Edwards [45] reports a case of severe reaction to tetanus toxoid and reviews the literature on this subject.

Thomas and Fenton [46] describes 7 reactions following the use of tetracaine hydrochloride. Three of the reactions terminated in death. Four reactions resulted from the use of the drug in bronchoscopic preparation or examination; three from the use of the drug in preparation for gastroscopic examination. Suggestions for control of such reactions are outlined, as well as precautions to be taken when tetracaine hydrochloride is used.

Tuft [47] gives a critical evaluation of cutaneous tests in relation to the diagnosis of allergy. He suggests standardization and improvement in the preparation of extracts of allergens so as to provide extracts which are not likely to cause reactions of irritation regardless of the method used. He urges that greater care be exercised in doing the tests. He suggests the abolition of the custom of reporting the intensity of the reactions, particularly to the referring doctor and more particularly to the patient himself. He suggests division of specific positive reactions into negative, doubtful and positive. He suggests wider application and standardization of the methods of clinical testing with respect to both positive and negative reactors and especially with respect to such inhalants as dust, feathers, goat hair and wool, which frequently evoke positive reactions. He says that some type of confirmation, whether by nasal inhalation or application or otherwise, is necessary to overcome the present dependency on clinical data, which are not always accurate or satisfactory. He urges that the present testing lists be reviewed

Spangler, R. H.: Allergic Findings in Epileptic ts and Ancestors, Ann. Allergy **1**:91-114 (Sept.-1943.

Fox, R. A.: Disseminated Lupus Erythematosus rgic Disease? Arch. Path. **36**:311-315 (Sept.) 1943.

Hennig, G. C.: Reactivity of the Skin, U. S. M. Bull. **41**:698-707 (May) 1943.

Baretz, L. H.; Harten, M., and Walzer, M.: ption of Protein from Urinary Bladder, J. Urol. -75 (July) 1943.

44. Swartz, H. F.: Allergic Manifestations in Atopic Individuals Following Injection of Tetanus Toxoid: Report of Two Cases, J. Allergy **14**:544-551 (Nov.) 1943.

45. Edwards, W. M.: Anaphylaxis After Injection of Tetanus Toxoid, J. Allergy **14**:552-556 (Nov.) 1943.

46. Thomas, J. W., and Fenton, M. M.: Fatalities and Constitutional Reactions Following Use of Pontocaine, J. Allergy **14**:145-159 (Jan.) 1943.

47. Tuft, L.: Critical Evaluation of Skin Tests in Allergy Diagnosis, J. Allergy **14**:355-367 (July) 1943.

by a selected group with the thought of eliminating those allergens which do not cause symptoms sufficiently often to warrant their inclusion. Finally he urges additional and more extensive chemical, physicochemical and immunologic investigation of allergenic extracts, particularly foods, in order to isolate the active incitants and, if possible, to determine their nature and antigenic relations. He says that some of the criticism of the tests and testing methods is probably undeserved. Some of it, however, is justified and attributable to the allergists' own indifference or complacency.

Frank, Blahd and Howell [48] describe the reaction of the normal and of the allergic sinus to virulent pneumococci. They injected virulent pneumococci into the sinuses of rabbits which had been previously sensitized to egg albumin and into the sinuses of normal controls. Histologic examinations disclosed similarity in the degrees of inflammation in the two groups.

Hilding [49] presents pathologic observations in persons dying of asthma and other respiratory diseases and calls attention to the fact that failure of the ciliary system within the respiratory tract may be a cause of death. He states that there is a group of persons who die from asthma who show a striking and characteristic change in the bronchial epithelium. This change has been noted briefly in the literature a number of times and has been rather fully described, but it does not seem to be understood, or its importance appreciated. It is entirely ignored in the majority of the descriptions of the pathologic aspects of asthma. The change consists in substitution of goblet cells or cells resembling goblet cells for the normal columnar ciliated cells. Apparently it is a true metamorphosis. As the metamorphosis takes place the ciliary mechanism is lost and the characteristic viscid mucinous secretion accumulates in the air passages. The destruction of the cilia prevents this viscid secretion from being carried up to the tical surfaces. The amount of secretion is enhanced because the erstwhile ciliated cells are secreting as well as the glands. When the air passages have become sufficiently filled, the patient dies of asphyxia. In the opinion of the author the metamorphosis is the chief pathologic change, and in his opinion death results directly from the loss of ciliary function.

478 Aquila Court.

48. Frank, I.; Blahd, M., and Howell, K. M.: Reaction of the Normal and Allergic Sinus to Virulent Pneumococci, Ann. Otol., Rhin. & Laryng. **52**:81-84 (March) 1943.

49. Hilding, A. C.: Relation of Ciliary Insufficiency to Death from Asthma and Other Respiratory Diseases, Ann. Otol., Rhin. & Laryng. **52**:1-19 (March) 1943.

News and Comment

OFFICERS OF THE PHILADELPHIA LARYNGOLOGICAL SOCIETY

At the annual meeting of the Philadelphia Laryngological Society held March 21, 1945, at the College of Physicians, the following officers were reelected for a term of one year: Horace J. Williams, M.D., president; George L. Whelan, M.D., vice president; Valentine Miller, M.D., treasurer; Thomas F. Furlong, M.D., secretary.

The following physicians were elected to constitute the Executive Committe: Drs. Louis J. Burns, Benjamin H. Shuster and Matthew S. Ersner.

Dr. Matthew S. Ersner was elected for a period of one year to serve the unexpired term of Dr. Robert Hunter, who is on active duty with the United States Navy.

Abstracts from Current Literature

Ear

PURE TONE SCREEN TEST OF HEARING. GORDON PETERSON, J. Speech Disorders **9**:114 (June) 1944.

is report gives the results of the testing of 3,393 en from the public schools of Indiana during the 1942-1943. The sweep check method was em-d, with use of both the Western Electric 6B and Maico 5D audiometer. The article contains a l description of the technic employed. The author ed 100 children per day. Of the 3,393 children, per cent failed on the first test. Retests were to 571, or 16.82 per cent; of these children, 294, 6 per cent, failed on the second test. One hundred hirty of this group had a loss of 20 decibels or r at two or more frequencies in one ear only, 64 had such losses in both ears. Eighty-four of hildren, or 2.48 per cent, had slight or greater rment of hearing for the comprehension of speech th ears.

PALMER, Wichita, Kan. [AM. J. DIS. CHILD.]

TORY ACUITY AND ITS RELATION TO DEFECTIVE PEECH. E. MARGARET SULLIVAN, J. Speech Dis-ders **9**:127 (June) 1944.

group of 1,501 children in the Minneapolis public l system whose speech is defective were studied light of audiometric tests against 25,708 elemen-chool children in the same school system who had se had audiometric tests. A slightly higher per-e of the total group with defective speech have of hearing in one or both ears. A considerably percentage of the stutterers, children with struc-articulatory difficulties and orally inactive children, a loss of hearing in one or both ears. Children faulty articulation of sibilants have no more loss aring than other children in the general public population. Significantly, however, not all chil-with defects of speech in the Minneapolis public system were studied, and among the control were many with defects of speech.

PALMER, Wichita, Kan. [AM. J. DIS. CHILD.]

UNTY SPEECH AND HEARING CONSERVATION PRO-AM. ALFRED LARR, J. Speech Disorders **9**:147 ne) 1944.

s article discusses the problem of meeting the of children handicapped in speech and hearing schools of Vigo County, Indiana. Group hear-sts and speech surveys were carried on in all s. First, teachers reported children who were ve in speech. Only 7 per cent of those reported not to have any defects. Children who presented or problems and children of low mentality com-the greater part of this group. Teacher educa-community education and follow-up work were lly organized. Mimeographed forms with printed tions were given to each teacher two weeks after hool year had begun, and three weeks elapsed any lists were collected from teachers. The ation of the study is that without the use of audiometers teachers in grades 1 through 6 tend to observe the existence of an 18 decibel or greater hearing loss in both ears but do not readily observe slighter losses in one or both ears.

PALMER, Wichita, Kan. [AM. J. DIS. CHILD.]

THE ROLE OF THE COLLEGE AND UNIVERSITY HEARING CLINIC. MIRIAM D. PAULS, J. Speech Disorders **9**:357, 1944.

College clinics for persons with defects of speech should correlate the services that are available to the deaf and the hard of hearing in the community. The author reviews the work of the Indiana State Teachers College Special Education Clinics, which shows that persons with a hearing loss of 25 decibels or more should study speech reading and that those with a loss of 40 decibels or more should consider using a hearing aid. Abifity to understand speech after the hearing aid has been fitted should be checked. The patient's intelligence, educational achievement, aptitudes and personality adjustment should be tested. There is a great challenge in the high incidence of acoustic handicaps to workers in many specialized fields. The establishment of broad programs for conservation of hearing, with adequate provisions for detection, medical attention, rehabilitation and prevention, can be insured only by the intelligent cooperation of the physicist, the otolaryngologist, the physician, the physiologist, the psychologist, the hearing therapeutist, the educator and the lay public. College and university hearing and speech clinics are prepared to give whatever support may be required to accomplish these aims.

PALMER, Wichita, Kan.

Pharynx

INDICATIONS FOR TONSILLECTOMY: A GENERAL PRACTITIONER'S OUTLOOK. B. EPSTEIN, South African M. J. **18**:59 (Feb. 26) 1944.

Epstein feels that removal of the tonsils is too often performed without adequate cause. He has frequently observed the failure of tonsillectomy to protect against the initial attack or the recurrences of rheumatic fever. The operation affords no relief from allergic rhinitis. Enlargement of the cervical lymph nodes in children is no indication for removal of the tonsils; the enlargement may be part of a generalized physiologic glandular enlargement or may be due to a virus infection. Definite indications for tonsillectomy and adenoidectomy are (1) repeated sore throat, (2) peritonsillar abscess, (3) mechanical obstruction to breathing and (4) recurrent attacks of otitis media or an abscess of the middle ear in a child. The operation is not without risk. The anesthetic occasionally causes death. Psychic trauma frequently follows the operation; bed wetting, irritability, insomnia and nightmares in children can often be traced back to exposure to an anesthetic. Bronchiectasis due to inhalation of infected material after tonsillectomy occurs in a not inconsiderable number of instances. The advisability of the creating of "tonsil consciousness" in parents by school nurses is open to question.

GONCE, Madison, Wis. [AM. J. DIS. CHILD.]

Larynx

CONGENITAL ATRESIA OF THE ESOPHAGUS WITH TRACHEO-ESOPHAGEAL FISTULA. ALBERT O. SINGLETON and MAYNARD D. KNIGHT, Ann. Surg. **119**:556 (April) 1944.

The symptoms are constant and diagnostic. The infant drools excessive amounts of mucus and saliva. He is subject to attacks of choking and cyanosis when taking fluids by mouth. If a soft rubber catheter is moved down the esophagus, it reaches an obstruction 10 to 12 cm. from the anterior alveolar margin. Associated anomalies are found in about one half of the recorded cases.

The history of congenital esophageal atresia and tracheoesophageal fistula is one of long and repeated failures in efforts which have been made to treat the condition. The authors favor the transpleural approach, with ligation of the fistula and primary anastomosis if technically possible. Four cases are reported.

BANTIN, Omaha. [AM. J. DIS. CHILD.]

ACUTE LARYNGO-TRACHEO-BRONCHITIS. F. ARDEN and J. V. DUHIG, M. J. Australia **1**:145 (Feb. 19) 1944.

Although various organisms have been held responsible for acute laryngotracheobronchitis by various writers, Arden and Duhig state that a disease with such uniform pathologic effects must be due to a specific etiologic agent. The pathologic changes, complete widespread necrosis of the tracheal mucosa and submucosal vascular dilatation without cellular exudate except for a scanty lymphocytic infiltration, are phenomena more in keeping with a virus than with a bacterial infection. The persistence of the mucous glands and their ducts—which, incidentally, excludes Corynebacterium diphtheriae as a causative agent—combines with the secondary infection to produce the gummy purulent necrotic material on the surface of the trachea. Contrary to the usual condition in influenzal infections, the lungs are not involved in acute laryngotracheobronchitis. Examination of the lungs reveals infective bronchitis but no bronchopneumonia. The symptoms, the signs and the treatment are fully discussed. The factors which have contributed to the improved outlook at the present time are (1) recognition of acute laryngotracheobronchitis as a clinical entity, (2) early relief of laryngeal obstruction by tracheotomy, (3) saturation of the inspired air with moisture and (4) the use of the bronchoscope to overcome bronchial obstruction.

GONCE, Madison, Wis. [AM. J. DIS. CHILD.]

Miscellaneous

CEREBROSPINAL RHINORRHEA. WILLIAM J. GERMAN, J. Neurosurg. **1**:60 (Jan.) 1944.

Cerebrospinal rhinorrhea is said to be a relatively common complication of craniocerebral injury in the frontal region. Spontaneous recovery may occur as late as eight weeks after the injury, and the condition may develop after an interval of several weeks. In cases of the chronic condition surgical repair is always advisable.

German describes a method of repair which has been employed successfully for the past five years. He utilizes a dural flap from the crista galli to cover the defect in the cribriform plate. He reports 5 cases in which this procedure was used with success. Medication with sulfonamide compounds is given for an appropriate period before and after operation. There no recurrences of the rhinorrhea, and in only 1 did meningitis (sterile) develop, with mild fever pleocytosis.

WHITELEY, Philadelphia [ARCH. NEUROL. & PSYCHIA

THE CHEMOTHERAPY OF INTRACRANIAL INFECTI IV. THE TREATMENT OF PNEUMOCOCCAL MI GITIS BY INTRATHECAL ADMINISTRATION OF P CILLIN. COBB PILCHER and WILLIAM F. MEAC J. Neurosurg. **1**:76 (Jan.) 1944.

Meningitis was produced in several groups of 14 dogs each by injecting type I pneumococci in cisterna magna. Half of each group of animals treated with penicillin, and the remaining half used as controls. A total of 96 experiments performed.

In the first series (48 experiments) 50 units of cillin was injected intrathecally daily, with slight definite improvement as compared with the cond of the untreated controls. In the second serie two groups of 12 dogs each, doses of 100 and 200 of penicillin respectively were injected intrathe daily; almost half the treated animals survived, most of the deaths were due to lobar pneum Because of the resulting pneumonia, a third s (24 dogs) were treated by injecting 200 units of cillin intrathecally daily and 1,000 units intraven three times daily; the results were even more favo than those in the second series.

WHITELEY, Philadelphia [ARCH. NEUROL. & PSYCHIA

ADVANCES IN THE CHEMOTHERAPY OF INFLUE MENINGITIS. M. L. BLUMBERG, E. TANNEN and M. GLEICH, J. Pediat. **24**:182 (Feb.) 1944.

Before the advent of chemotherapy the mortality from influenzal meningitis was 95 to 100 per cent. use of sulfonamide compounds and serum has re this to about half.

From January 1936 to June 1943 there wer patients with influenzal meningitis at Harlem Ho in New York. Their ages ranged from 10 mont 4½ years. They were all treated with sulfon compounds, and 6 patients were given influenzal serum intrathecally, intravenously or by both r Three patients were treated with sulfadiazine, su mented for 1 patient with influenzal antiserum. A of 1½ grains of sodium sulfadiazine per pound of weight (0.18 Gm. per kilogram) as a 5 per cent aq solution was administered in divided doses at the of one every four hours beginning four hours afte initial dose, which was one half of the total daily Intravenous injection of the drug was continued definite improvement was noted, and then the drug given orally. After ten to fourteen days of therap dose was reduced, and finally administration of the was discontinued. Of 7 patients treated with sulfa dine or sulfadiazine, only 2 died. Two patients tr with sulfadiazine were the only ones who reco without receiving serum. In all, 6 patients died, 5 (45.4 per cent of the series) were cured and sh no complications.

BLUMBERG, New York. [AM. J. DIS. CHI

ELECTROENCEPHALOGRAPHIC STUDY ON THE MOMENT OF STUTTERING. NORMAN WILLIAM FREESTONE, Speech Monogr. **9**:28, 1942.

The author reviews all previous studies of the same problem, showing that there is no general agreement in the conclusions. Twenty normal speakers and 20 stutterers, chosen without regard to handedness, were studied by means of a Gras electroencephalograph as to left and right frontal areas 1 to 6, left and right central motor areas 2 to 5, left and right occipital areas 3 to 4 and left and right upper motor areas 7 to 8. The author does not report the sex distribution. Many of the previous findings failed to be confirmed. In many cases the brain potentials of stutterers are statistically different from those of normal persons.

The following general conclusion is reached: Psychological stimuli must impinge on certain basic neurologic differences before stuttering can result. These differences are due to a lack of heightened foci of cerebral activity, a condition which is akin to reduced consciousness.

The following specific conclusions are reached: 1. Stutterers are neurologically differentiated from normal persons. 2. The proper stimulation of the neurologic differences forces stutterers to function in a relative state of reduced consciousness. 3. States of reduced consciousness, seen as a lack of heightened foci of cerebral activity, militate against the establishment of a dominant speech gradient. 4. The Travis hypothesis of lack of speech gradient for stutterers is at least partially supported.

PALMER, Wichita, Kan. [AM. J. DIS. CHILD.]

ATROPHY OF THE ALA NASI FOLLOWING TRIGEMINAL DENERVATION. J. SCHORSTEIN, J. Neurol. & Psychiat. **6**:46 (Jan.-April) 1943.

Schorstein draws attention to a new syndrome which he observed in 8 cases of trigeminal denervation following resection of the nerve or injection of alcohol into the Gasserian ganglion. In the resulting anesthetic area of anesthesia erosion of the ala nasi occurred and was frequently associated with paresthesia, self-inflicted trauma, necrosis, nasal fissures and facial ulcer. The author is of the opinion that erosion of the nostril results from self-inflicted injury in an attempt by the patient to relieve himself of paresthesia. A contributing factor is the diminished resistance of anesthetic skin to infection. The progression of the lesion may be determined by failure of the cutaneous vasodilator reflex. Treatment consists in covering ulcers and fissures with a bland ointment. The patient must be warned against manipulating the skin.

MALAMUD, Ann Arbor, Mich.
[ARCH. NEUROL. & PSYCHIAT.]

PATULIN IN THE COMMON COLD: COLLABORATIVE RESEARCH ON A DERIVATIVE OF PENICILLIN PATULUM BAINIER. HAROLD RAISTRICK and others, Lancet 2:625 (Nov. 20) 1943.

Patulin (a derivative of Penicillium patulum Bainier) was found to be about equally bacteriostatic to both gram-positive and gram-negative organisms. It was much less active than penicillin against gram-positive organisms but much more active against gram-negative organisms.

During four months patulin was given a trial in the treatment of common colds prevalent at a naval establishment. Solutions of the substance were sprayed in the nose or snuffed up from the hand. The results obtained were encouraging: 57 per cent of the treated patients recovered completely in forty-eight hours, compared with only 9.4 per cent of the controls.

LANGMANN, New York. [AM. J. DIS. CHILD.]

UPPER RESPIRATORY TRACT INFECTIONS. F. M. BURNET, M. J. Australia **2**:393 (Nov. 13) 1943.

Burnet presents an excellent discussion of infections of the upper respiratory tract. The material is considered under the following headings: (1) the causes of the common infections of the respiratory tract, (2) the experimental study of influenza, (3) the recent incidence of influenza in Victorian camps, (4) the pathogenesis of influenza and (5) the control of infections of the respiratory tract. In the discussion of the last-mentioned aspect of the subject Burnet states that two pronouncements can be made. The first is that a large proportion of the winter respiratory and pharyngeal infections are not influenzal but are due partly to viruses not yet isolated and partly to bacterial pathogens. No immunologic approach to the control of these infections is yet possible. The second is that in a clearcut epidemic of virus influenza the evidence suggests that immunizing susceptible persons either by subcutaneous inoculation of formaldehyde-killed virus or by intranasal administration of living attenuated virus will reduce the incidence to a moderate degree. No method has yet been conclusively proved to be effective, and the most that has been claimed is a 50 per cent reduction in morbidity. Such a moderate degree of success may conceivably make it worth while to immunize large groups of persons engaged in important work, but it is hardly sufficient to suggest that immunization would be worthy of general application. Smorodintseff's report of production of persons exposed to an epidemic by inhalation of immune serum in the form of a mist should be treated with reserve until the experiments have been repeated. It is not unlikely that some modification of his method may become the best practical means of protecting against influenza in the midst of an epidemic. It is always possible that a specific chemotherapeutic agent will be discovered and will render all immunologic methods obsolete. If a pandemic of the 1918-1919 type should reappear, it will be a matter of major importance to know whether the fatal outcome is essentially due to bacterial action and hence to be prevented by the use of sulfonamide drugs or whether the damage due to the virus is itself sufficient to cause death. In the latter circumstance no chemotherapeutic agent at present known would be of any value.

GONCE, Madison, Wis. [AM. J. DIS. CHILD.]

Directory of Otolaryngologic Societies *

NATIONAL

All meetings, except that of the American Academy of Ophthalmology and Otolaryngology, have been canceled.

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Secretary: Dr. Paul Holinger, 700 N. Michigan Ave., Chicago 11.

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Secretary: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis.

American Laryngological, Rhinological and Otological Society, Inc.

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Secretary: Dr. C. Stewart Nash, 708 Medical Bldg., Rochester 7, N. Y.

SECTIONS:

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Middle.—Chairman: Dr. Carl H. McCaskey, 608 G anty Bldg., Indianapolis.

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American Otological Society

President: Dr. Gordon Berry, 36 Pleasant St., W cester, Mass.

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American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Morris S. Bender, 121 E. 60th St., N York.

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* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

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